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Editorial Notes

Alternative Motor Fuels

THE attendance at a meeting of the Royal Society of Arts on Wednesday last, representative of a wide—one might almost say complete—range of fuel interests, was fitting tribute to the pioneering work of Dr. C. M. Walter, who read a Paper on "Alternative Motor Fuels." This Paper, an extract from which will be found in to-day's "JOURNAL," brought a nice balance to bear on the whole subject, the Author discussing the use not only of compressed town gas as an alternative to petrol in the internal combustion engine—regarding which he is a recognized authority—but also producer gas and methane and sludge gas. He presented the picture in admirable perspective, which fact doubtless accounted for the excellent discussion to which the contribution gave rise. If this war is going to last a long time, and indications are not lacking that it may well do so, the sooner schemes are formulated for the application of home-produced fuels alternative to petrol for motor transport, the better. As far as compressed town gas is concerned, the technique has been developed, largely as a result of the work of Dr. Walter and his collaborators, and is well understood. The Committee on the Emergency Conversion of Motor Vehicles to Producer Gas, appointed in May of 1937, has issued its report giving particulars of a recommended design of producer and a recommended choice of suitable fuels. The Electrical Development Association is setting out on an intensive campaign to further the employment of the electrically propelled vehicle. The field of replacement is so vast that the element of competition between home produced fuels or sources of energy does not enter into the issue. The crux of the problem is how quickly, in this state of emergency, conversion of vehicles from petrol to alternative fuels can take place.

The economics of the situation must be viewed through war-time spectacles and it cannot be emphasized too strongly that these alternative fuels can render transport mobile which might otherwise under prevailing conditions be lying idle, and that the Gas Industry could make available alternatives to petrol in gaseous and solid form. Low-pressure gas has its sphere of application; compressed town gas has its sphere, and a less limited one; producer gas appears to us to have its separate field for long-distance heavy haulage work where the load is not intermittent; and we must not lose sight of the steam driven vehicle using coke. We cannot see the need within the Gas Industry for controversy regarding low-pressure and high-pressure gas. In either form town gas is a useful and serviceable fuel. The capital involved in compressed gas schemes is not light, but, granted a lead from the Government, cannot be regarded as an insurmountable barrier. Serious consideration should be had to the giving of priority to steel for the making of the needed compressors and vehicle cylinders for containing gas. We have already been at war for six months, and as yet there has been no lead in the matter. The time is ripe for decision.

In regard to producer gas, the Fuel Research Station has been carrying out extensive experiments on the production of suitable cokes. During the discussion on Dr. Walter's Paper last Wednesday a member of the Fuel Research staff expressed confidence that it will be possible to manufacture suitable fuels by high-temperature carbonization as practised at gas-works, with, maybe, a slight reduction in temperature, slight modification in technique, and with the exercise of care in the selection of coals. The fuel produced, it was argued, would have a premium value, and its production would represent a sound economic proposition for the Gas Industry. It is not our intention at the moment to discuss the economics of producing suitable producer-gas fuel, but it is obvious that in providing fuels alternative to petrol for the internal combustion engine, and in providing the fuel for steam driven vehicles, the Gas Industry has several strings to its bow. It can offer gas at low pressure and at high pressure, it can offer coke for raising steam, it may be able to offer the requisite fuel for use in producers for motor vehicles. To our mind the aim should be not concentration on any one alternative to petrol, but rather attention—and very close attention—to all alternative fuels, of which the Gas Industry has such a huge potential reserve. Dr. Walter's Paper last Wednesday was opportune in stressing the possibilities in this direction which undoubtedly lie in the Industry.

The Truce

WE are pleased to hear that the position as regards the so-called "truce" may shortly be crystallized, and that some definition may be forthcoming of the interpretation which "official" gas puts upon it. It remains to be seen whether or not this will be found satisfactory by the Industry in general, and accordingly whether individual gas undertakings will feel themselves bound in honour, or in any other wise, to desist from their normal efforts to sell more gas. Our own

view is that the question can quite safely be left to be ruled by the conditions of to-day. Nobody, we believe, is in the happy position of being able to indulge in cut-throat competition, yet it cannot possibly be desirable from the national point of view for the Gas Industry to stand quietly by and contemplate with equanimity a period of complete stagnation in its business. Judging by a circular instruction recently issued by the Electricity Commissioners to local authorities, this is precisely the view taken in high quarters on that side, and, while it would be obviously wrong at the present time for either industry to seek unnatural expansion by artificial means to the other's detriment in a way which might necessitate heavy capital expenditure, normal competitive development is essential to the wellbeing of both.

In view of the forthcoming clarification of the position on the gas side, we will not comment further at the moment. Not long ago we explained our reasons for disliking at all events a badly defined truce, which seemed to many gas undertakings, as far as their own areas were concerned, a very one-sided affair. Since then a steady anti-truce chorus has come from the electrical Press, and it is to be hoped that some better understanding of what is really intended may soon clear the air.

B.C.G.A. Activities

THE normal, and perhaps more obvious, activities of the Association have of course been curtailed during the period of settling down to war conditions, and in seeking fresh orientation for them it has been necessary to consider very carefully to what extent direct competition with the old "enemy" is to be carried on, or whether energy could be directed into nationally more profitable channels. Even if there had been no talk between the industries of such an understanding as has been named the "truce," it would have been essential for the Association to take careful stock of the position.

In this period when circumstances excluded activity of the more forceful type, it has none the less accomplished quietly a considerable amount of useful work. Assistance of an individual nature has been given to undertakings which needed it, excellent issues of "A Thousand-and-One" have appeared, and the *Flambeau* has kept well up-to-date with the changed conditions of life. Distribution of the latter, by the way, seems to us an excellent line for gas undertakings which have been compelled by circumstances to curtail normal forms of local publicity. One of the best signs for the health of the Industry has been the continued demand for display work on the studio, which, as Mr. Rowe told the Scottish Juniors recently, has been working at high pressure. The film library service, after a brief break at the outset, was resumed as far as transport and other conditions have permitted, and more than 1,000 shows have been given to a great variety of audiences.

In the meantime preparations for fresh activities have been going ahead, and we understand that a "prestige" campaign is shortly to be launched, which we hope will have the desired effect of reminding the nation how vital is the Gas Industry's part in wartime. It will be remembered that electricity blossomed forth a month or two ago with some very forceful announcements of its part in winning the war. We surely have no less striking a tale to tell. We understand, also, that the Association is co-operating in full measure with the Ministry of Food in the organization of a nation-wide food education campaign, to which no doubt the Industry will give its fullest support. And no industry is better qualified, as regards knowledge, personnel, or appliances, to help the country in this vital branch of its war effort. We look forward with great interest to these and other manifestations, of which we have heard reports, of the progressive spirit of our Industry. We cannot stand still. We either go forward or we slip back; and the nation can least of all at this time afford any retrogression in the Gas Industry.

Rising Consumptions

REFERRING a week ago to the operations during the past troubled year of certain Gas Companies, the remark was made that nothing in connexion with them had happened to diminish confidence in the future outlook from the point of view of the proprietors. This is a heartening reflection, at a time when encouragement is especially to be valued, and it is gratifying to find additional proof forthcoming from various parts of the country of the fact that, but for the war, 1939 would have been a really satisfactory year for the Gas Industry in general. This should be kept firmly in mind by investors who have to face for the time being a shrinkage in the market value of their stocks. The present state of affairs appears to us to be eminently a case for the "long" view.

Readers will have seen three further examples of the soundness of the contention that all is well with the Industry in the reports of the proceedings at the meetings of the Bournemouth, Bristol, and Southampton Companies, which appeared in the last issue of the "JOURNAL." They are enterprising undertakings, all of them, and they show how sound is the basis upon which the Industry of gas supply is built. In spite of a considerable drop in the consumption of gas for public lighting, the Bournemouth Gas and Water Company have been able to record an increase of slightly over 2% in the total gas sales over the whole year, while in the same period 2,000 and more new consumers have been added to those previously on the Company's books. These are the points upon which one may most profitably dwell in the peculiar circumstances of to-day. Costs are extremely high—and will be even higher—in consequence of the abnormal conditions existing, and this, in its turn, is leading to increased charges for gas, which, again, in a number of cases must have consequential effects upon the dividends declared. The higher price, too, must to a certain extent act as a brake upon gas usage.

For the time being, therefore, it is not by reference to the financial aspect, so much as by study of the barometer of "business done," that we would wish the Industry to be judged. It has, however, to be remembered that, even in the matter of sales of gas, some undertakings, as the reports of the Metropolitan Gas Companies indicate, have been sorely tried by prevailing adverse circumstances. This was only to be expected, at a time when the desperate situation of traders and professional and business people in London who are suffering hardship brought about by the war was the subject of a petition organized to point out to the Government the need of immediate action. Not long ago the statement was made that "thousands of shops in London had closed their shutters," and great numbers were facing ruin as a result of evacuation, the black-out, and the restriction of traffic. It was declared that the population of London had been reduced from eight millions to five millions, and that "those who had gone away were the people with most money."

The Chairman of the Bournemouth Company, Mr. William Cash, when referring to the recent increase in the price of gas, pointed out that, under the provisions of the Company's sliding-scale, this will affect the dividend for the current year, subject to any statutory relief which they may get; and we feel sure the consumers will appreciate the justice of his claim that it is essential that the Company's financial position should be maintained. "We have," he said, "to issue additional capital, and to do that you must be able to show that you can earn sufficient money to provide a return on it." In this connexion, he added the cheering news that, in view of the abnormal demand for gas due to recent weather conditions, the sales of gas so far this year have increased by more than 20%.

The tale which the Chairman of the Bristol Gas Company, Mr. George H. Boucher, had to tell the proprietors was one of continued progress. An increase in consumption of a trifle over 3½% has been due to larger sales in every branch of the Company's business—except, of course, public lighting. "If war had not broken out," he said, "we should have had a

very wonderful year, as the quantity of gas sold before the beginning of September showed an increase of 6½% over the previous year." Wartime conditions have led to the curtailment of certain of the Company's activities, in the direction of propaganda and publicity. This, of course, is only a temporary measure, and we must all hope that early full resumption of so vital a part of the Industry's work may be possible.

The figures of the Southampton Gas Light and Coke Company quoted by the Chairman, Sir Russell Bencraft, are equally full of promise, though in this case, in addition to the other restrictive influences generally experienced, evacuation from the district of a large number of the inhabitants left its mark on the year's results. Prior to September there had been satisfactory increases in gas sales, however, and the final figures for the year (in spite of the decrease after the outbreak of war) show a net increase of just over 3%. The consumption in the Winchester area alone shows an increase of almost 5½%. The number of consumers is practically 2,000 up on the year, and altogether it must be felt that the Gas Company have as good reason to be pleased with Southampton as Southampton has to feel proud of its Gas Company.

Peacetime Trends

THE outbreak of war inevitably led to delay in the publication of the annual report of the Secretary for Mines, and as the report just issued relates to 1938 the figures appear somewhat remote. Many of them, however, are of interest to the Gas Industry. True they concern pre-war conditions, but they indicate natural trends in the Industry. The peacetime picture they present is not particularly inspiring; it shows how slow-moving the Industry is. In 1937, in spite of the greater amount of coal carbonized, there was an extremely small increase in the amount of benzole recovered compared with 1936. The increase was, in fact, only 0.7%. Commenting on the figures in the "JOURNAL" we suggested that "gang warily" with benzole recovery would seem to be the attitude of the Industry, but we expressed the opinion that the Secretary for Mines' reports for 1938 and 1939 might well reflect a change in the 1937 attitude.

Well, there was a change in 1938, as shown by the present report, but not such as our optimism led us to anticipate. The output of refined motor spirit at gas-works increased by 5% over that of 1937. This is attributed partly to a slightly increased yield of crude spirit per ton of coal carbonized by those undertakings which extracted spirit—2.24 gallons compared with 2.21—partly to the fact that a certain number of works operated recovery plants for the first time during the year, and probably partly to increased proportionate yield of refined spirit from crude. It will be agreed that the increase can hardly be described as sensational, and the fact stands out that in 1938 benzole was scrubbed from the gas from only a little more than half (actually 53.1%) of the total coal carbonized at gas-works. On the other hand, almost all the gas made at coke ovens was scrubbed, the corresponding figure given in the report being 98.5% of the gas from the coal carbonized.

Other figures set out in the report of the Secretary for Mines reveal further peacetime trends which are of interest to the Gas Industry. The output of creosote from the carbonizing process increased in 1938. There was a substantial increase in the production of refined motor spirit at the hydrogenation plant of I.C.I. at Billingham. The total production was 42.3 million gallons, compared with 35 million gallons in 1937. The quantity of coal consumed in this production, however, was only slightly greater than in 1937. The increase in production was chiefly due to the larger quantities of creosote and other liquid tar products hydrogenated.

As for low temperature carbonization, the amount of coal treated at the 13 plants in operation was 520,386 tons, an increase of 8%. The coke produced—and over 90% of it must have been "Coalite"—increased in like amount, the quantity per ton of coal being 15.7 cwt. Up to the end of 1938 the amount of low temperature coke produced showed a rise of 155% over the quantity made in 1930, and in an interim report to shareholders last month the Chairman of Low Temperature Carbonisation, Ltd., stated that in spite of numerous difficulties introduced by the war the sales of "Coalite" have exceeded all previous figures and that the position and prospects of the Company "were never better than they are to-day."

There is just one other trend to which we would refer which is brought out by the figures given in the Secretary of Mines' report, and that relates to the use of pulverized fuel for central heating. In 1938 nearly 2,000 tons were used for this purpose, compared with 1,200 tons in 1937 and 200 tons in 1936. This development has been encouraged by the facilities offered for obtaining delivery of this type of fuel by road or rail tank wagons, as in the case of oil fuel, or in waterproof paper sacks.

Faith in the Future

No little gratification should be derived from the pages of this week's "JOURNAL" which refer to the opening of four new gas showrooms in different parts of the country—Wolverhampton, Newcastle-under-Lyme, Walkden, and Eccles. These are just a few of many new service centres which have been opened since the outbreak of the war, and the fact that these four all happen to fall in the same issue provides an opportunity for the comment that they reflect the confidence which is felt in the future of the Industry. During the first six months of war advantage has been gained by the efforts of those undertakings who have striven, so far as possible, to maintain their helpful service organizations. Apart from the direct value of these new showrooms to the undertakings themselves, they have a prestige value which is of great encouragement in these difficult days. They demonstrate that the Industry, in wartime as in peacetime, is concerned with service to the consumer.

"Gas Journal" Directory

In order that readers may be able to keep the particulars contained in the "JOURNAL" Directory up to date, we summarize in the following list various changes of which we have been notified during the past month:

Page 50. NEW MILLS. W. E. Plevin appointed E. & M. *vice* J. S. Brown, deceased.

„ 56. PUDSEY. E. B. Craddock appointed Acting M.; J. H. Brooke, S.

„ 68. SWINDON. G. Fitton appointed W.M.

Forthcoming Engagements

March

9.—Manchester and District Juniors.—Meeting at Manchester; Address by Sir Frederick West.

11.—I.G.E.—Finance Committee, 1.45 p.m.; Membership Committee, 2.15 p.m.; General Purposes Committee, 3 p.m.

11.—L.C.C.A.—Finance Committee, 10.45 a.m.; Executive Committee, 11.15 a.m.; Central Committee, 2.15 p.m.

12.—I.G.E.—Council Meeting, 10 a.m.

12.—N.G.C.—Central Executive Board, 2.30 p.m.

13.—L.C.C.A. Coke Salesmen's Circle.—Meeting at Gas Industry House, 3 p.m.

13.—Southern Association.—Eastern District Meeting, Gas Industry House, 11 a.m. Discussion on current topics.

14.—Gas Research Board.—Methane Panel of Joint Committee on Complete Gasification under Pressure, 10.30 a.m.

14.—B.C.G.A.—Annual Meeting of Members in the South-Western District, Imperial Hotel, Exeter, 2.15 p.m.

14.—Institute of Fuel.—Meeting at Connaught Rooms, W.C.2, 6 p.m. Paper by A. F. Webber, "Regenerative Feed Heating in Industrial Power Plants."

14.—I.G.E.—Specifications Sub-Committee of the Refractory Materials Joint Committee, 11.30 a.m.

14.—Midland Juniors.—Meeting at Council House, Birmingham, 6.15 p.m. Discussion on current topics.

14.—B.C.G.A.—Annual Meeting of Members in Eastern District (Eastern Section), Angel Hotel, Bury St. Edmunds, 2.30 p.m.

14.—Gas Research Board.—Refractory Materials Joint Committee, 2.30 p.m.

15.—I.G.E.—Liquor Effluents and Ammonia Committee, 11.30 a.m.

15.—Gas Research Board.—Joint Research Committee, 2 p.m.

Personal

As we go to press we learn of the retirement of Mr. C. F. BOTLEY, M.Inst.C.E., from his position as Engineer and General Manager of the Hastings and St. Leonards Gas Company, thereby terminating a family connexion with the Company of over 53 years. Mr. Botley's father was appointed Engineer and Manager in 1887, and Mr. Botley commenced as Engineering Assistant in 1891.

Mr. John H. HORNBY, Engineer and Manager of the Maidstone Gas Company, has been appointed to the post vacated by Mr. Botley.

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At a recent gathering at the Deal Gas-Works, which was attended by eighty members of the staff, a set of bowls and a case of pipes were presented to Mr. J. F. TYNDALL, for the past 18 years Engineer and Manager of the Deal and Walmer Gas Company, who retired at the end of last year.

* * *

The appointment is announced of Mr. E. B. CRADDOCK as Acting Manager of the Pudsey Gas Company, while Mr. JOHN H. BROOKE has been appointed Secretary. The Company is a subsidiary of the United Kingdom Gas Corporation.

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Mr. G. FITTON, B.Sc., Deputy Engineer and Manager of the Dewsbury Gas Department, has been appointed Works Manager of the Swindon United Gas Company.

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Mr. R. PRINCE, General Manager and Secretary of the Peterborough Gas Company, broke his right arm when he slipped on some ice outside his house in the darkness on Feb. 20. He was taken to Peterborough Hospital for treatment, and the injury is progressing satisfactorily.

Obituary

Robert Poole

At the age of 55, Mr. ROBERT POOLE died in a nursing home in Manchester on Friday evening, Feb. 23, after having undergone a serious operation.

In 1899 Mr. Poole joined the Richmonds Gas Stove Company, Ltd., straight from school. During his forty years of service with them he rose by sheer merit and outstanding ability, to Office Manager and thereafter to Sales Manager, Commercial Manager and Secretary, General Manager and Director, and in June of last year he was elected to the position of Chairman and Managing Director of the Company.

Mr. Poole played a conspicuous part in the building up of this Company—one of the constituents of Radiation, Ltd.—and his untimely passing is a loss which will be felt most keenly not only by the personnel of the organization of which he was Chairman, but by the wide circle of his business and personal friends. Mr. Poole owed his success not only to his untiring energy and outstanding business acumen but also to his personality and understanding of men. He was an encouragement and inspiration to all who worked with him, and had that rare gift of passing on his enthusiasms to all with whom he came in contact.

News of his passing will also be learned with regret by many in Ilford and Woodford where, prior to his departure early in 1932, to take up his appointment at Warrington, he was well known and esteemed for his public activities.

Cremation took place in Manchester on Wednesday, Feb. 28, when a large number attended the Service, including the Radiation Board of Directors and Directors of Associated Companies. Among representatives of the Industry were Sir Frederick West (The Institution of Gas Engineers), Mr. J. H. Cadman (British Commercial Gas Association), and Mr. C. G. Langford (Society of British Gas Industries).

The sympathies of his many friends within the Industry will be extended to Mrs. Poole and his two daughters.

W. H. Sherburn

The death of Mr. W. H. SHERBURN took place on Feb. 21 at his residence near Warrington. Born in Rotherham almost 87 years ago, he served an apprenticeship to patternmaking in that then centre of the stove grate industry. He subsequently designed and executed cast-iron work for W. & A. C. Russell & Co., of Manchester, and later became associated with Thomas Fletcher, of Warrington, with whom he was identified when the amalgamation into Fletcher Russell & Co., Ltd., was completed. For a short time he was with R. & A. Main, Ltd., during which period he entered the Falkirk Town Council and served on the Gas Committee of that town.

His business connexion with Richmonds Gas Stove Co., Ltd., began in 1901 and continued to his retirement, while he acted in a consulting capacity until his decease. One of the pioneers of interchangeability and simplicity in construction, his efforts were closely associated with many of the appliances which that Company produced.

He was founder of the Institute of British Foundrymen, of which he became a life member, and the "Oliver Stubbs" Gold Medal was awarded to him for outstanding work for that body. For many years he was a Fellow of the Royal Society of Arts.

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The death has recently taken place of Alderman ALFRED BAKER, J.P., of Tewkesbury, at the age of 93. Alderman Baker was Chairman of Directors of the old Tewkesbury Gas Company for a long period, and a Director for 46 years. He was also a Director of the Upton-on-Severn Gas Company.

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Mr. ARTHUR BREARLEY, Works Manager to Robert Dempster & Sons, Ltd., Elland, died at his home at Elland on March 1. He had been with the firm for 39 years.

* * *

Mr. JAMES SCOTT, a Director of Hawick Gas Company, has died at the age of 85.

Letters to the Editor

The Coal Industry

SIR,—Dr. Foxwell's letter is interesting but very discursive and singularly evasive. His imaginary consumer rambles on through a land of dreams, ignoring the realities of the coal mining industry and repeating vague charges of excessive profits, increases of 4s. to 6s. per ton in the price of coal, &c., matters with which I dealt in my previous letters.

However, I said in my last letter that I would like to see better relations established between the gas and the coal mining industries. They are closely connected and the difficulties the Gas Industry has experienced of late should give those in control of it a little better understanding of those experienced in coal mining during the last ten or twelve years. A perfect parallel can be found in the second paragraph of Dr. Foxwell's letter. This can easily be paraphrased to apply to the Gas Industry and would then read thus: "Events have so worked out that the Gas Industry cannot maintain its reasonable profit . . . This can be remedied by charging more for the gas and that step has been taken with Government approval in order to put the Industry on a financially sound basis."

Dr. Foxwell raises again the old parrot cry of inefficiency, but gives it a new rendering. He wants to know "why the coal industry should not also be modernized?" I'm afraid he's a bit of a Rip Van Winkle. The coal mining industry has been modernized. British collieries to-day are among the most up to date in the world, thanks to the millions of new capital which has been sunk in them since 1926. The ex-President of the Mineworkers' Federation, Mr. Joseph Jones, now a member of the Coal Commission, has declared: "On its purely mining side, there is nothing wrong with the coal industry. Its mining engineers, managers, and technicians are among the best in the world." (The Coal Scuttle, p. 150.)

As for concentration on larger units, whatever may be the case in other industries, efficiency and "bigness" are not synonymous terms in the coal industry. A single pit may be an economic productive unit in one district and a similar pit in another district economically unworkable, for a variety of reasons, while it is well known that the moderate sized concerns are more successful than the very large ones. In addition, this suggested concentration raises a grave social problem, for the Act of 1930, establishing the quota system, was designed expressly in the national interest to spread the volume of employment and prevent the creation of more distressed areas.

The Cannock Gas Company case which he quotes is merely an illustration of how well the consumer is protected by the Committees of Investigation. The Company won its case. The price was reduced and the quantity increased. ("GAS JOURNAL," Feb. 22, 1939.)

I still am unable to agree that it is in the national interest that this complex industry should be subject to any greater measure

of legislative control, and if Dr. Foxwell would be good enough to do me the honour of reading the chapter on "State Control" in my book, he will see why.

Yours, &c.,
J. P. DICKIE.
Author of "The Coal Problem."

15, Pollards Hill South,
Norbury, S.W.16.
March 4, 1940.

Ice in Gasholders

SIR,—Is not the statement of your contributor ("JOURNAL," Feb. 28, p. 453) based on a wrong premise?

I refer to the statement: "The coolest water in the tank rises to the surface, owing to the fact that when the temperature approaches freezing point, *the density of the water decreases.* This phenomenon accounts for the water commencing to freeze at the surface first."

This winter, in my attic, ice formed on the bottom and sides of the cold water tank, and also on the surface of the water, so that the remaining water was completely surrounded by ice. Similarly, water contained in a glass jar or a bucket freezes on all its periphery.

Therefore, I submit that the ice forms first at the surface of the water in a gasholder tank. *only because the surface water is the coldest water,* having received more weather-cooling due to the particular construction and circumstances of a gasholder tank.

Yours, &c.,
H. J. TOOGOOD.

43, Uxbridge Road,
Hampton,
March 2, 1940.

News of the Week

It was Agreed at the February meeting of Newark Town Council that tenders be invited for a coke-screening plant.

Sanction has been Given by the Ministry of Health to the Mansfield Gas Committee to the borrowing of £1,000 for the provision of mains, the loan to be repaid in 30 years' time.

Important Extensions at the gas-works are contemplated by the Hereford Gas Department. A tender by the Woodall-Duckham has been accepted, and application is to be made for a loan of approximately £30,000.

After Considering a Report from the Gas Engineer (Mr. A. B. Britton) on the subject of emergency street lighting, the Hinckley Urban Council decided that fittings should be obtained to enable certain of the street lamps in the town to be relighted.

Notification has been Received by the Newark Gas Committee that the Minister of Health has sanctioned a loan of £1,000 for the purchase of appliances and £300 for services, representing an allowance for one year's prospective expenditure from Sept. 13, 1939.

A Recommendation to extend the carbonizing plant at the Foleshill works at a cost of approximately £227,000 has been approved by the Coventry City Council. It is proposed to replace eight beds of horizontal retorts by seven beds of vertical retorts, which will give a substantial increase in productive capacity.

Members of The Institution of Gas Engineers will be welcome at a meeting of the Institute of Fuel to be held in the Connaught Rooms, Great Queen Street, Kingsway, W.C.2, at 6 p.m., on Thursday, March 14, when a Paper will be presented by Mr. A. F. Webber, A.M.I.Mech.E., on "Regenerative Feed Heating in Industrial Power Plants."

The Treasurer of Skegness Gas Committee reported at the Committee's February meeting that it would be necessary to realize the investments in the Gas Reserve Fund—of the nominal value of £4,450—for the purpose of (a) meeting the loss on the current year's working of the undertaking, and (b) for purposes of financing the Undertaking. It was agreed that the investments should be sold and the matter left in the hands of the Treasurer and two other members.

Stories of the Severe Weather experienced a few weeks ago continue to be related. One, which illustrates devotion to duty in extremely trying circumstances, was told at the Annual Meeting of the Bath Gas Company. Mr. J. Wesley Whimster mentioned that half a dozen of the Company's employees living at Wellow and Timsbury walked all the way to Bath during the heavy snowfalls in order to commence work at 6 a.m. To do this, he pointed out, they had to leave their homes at two o'clock in the morning. "They did it because they knew we were short-handed and required every man available," Mr. Whimster added.

Much Useful Information on the fuel requirements of A.R.P. services is contained in the current issue of "A Thousand-and-One Uses for Gas," published by the B.C.G.A. Believed to be the first compilation of its kind, "A.R.P.—A Job for the Gas Industry," the booklet lists the needs of various services and the methods of meeting them—"not only to increase the efficiency of the arrangements made for the protection of the population, but also to add to the comfort of the large number of volunteers for Civil Defence." Among the subjects covered are the equipment of depôts and living quarters, medical services, and canteens. A note is added on street lighting and direction signs, and details are given of the way in which some cleansing stations have been adapted to provide bathing facilities for evacuee children.

The Reconstruction of No. 2 setting of six retorts is being put in hand by the North Berwick Gas Department.

During January a total of 36,495,000 cu.ft. of gas passed out of the Mansfield gas-works—an increase of 3,790,000 cu.ft. over the corresponding month in 1939.

3,700 Gas Units are to be installed by the St. Helen's Corporation Gas Department for the wartime lighting of the County Borough. It is gratifying to note that this progressive local authority regards the lighting of the residential and side streets as equally necessary as the principal thoroughfares.

A Scarf made by Mr. W. H. Wintringham, Managing Director of the Great Grimsby Gas Company, was on show in a display of knitted comforts at a coffee party organized by the Grimsby Branch of the Women's Gas Council. Some of the women members were quite jealous of Mr. Wintringham's skill with the needles!

The Power of Advertising and the patience of the Post Office were well illustrated when Radiation Publications Department, 7, Stratford Place, London, W.1, received a letter, the envelope of which was addressed as follows: "Regulo New World Gas Cookers, A Radiation Product, See them at your Gas Showrooms, London, W.1." The post-mark showed that no delay had been experienced.

Wartime Street Lighting came to Wellingborough on Feb. 26 with 50 gas lamps, and as the remainder of the order of lamp fittings comes to hand further lamps will be brought into commission. A total of 250 fittings has been ordered by the Urban District Council for Wellingborough and Finedon, and the work is being carried out by Wellingborough Gas Company under the street lighting contract.

The Next Meeting of Members of the Fuel Luncheon Club will take place at the Connaught Rooms, Great Queen Street, Kingsway, W.C.2, on Wednesday, March 13, at 12.40 for 1.10 p.m., when the after Luncheon Address on "Producer Gas for Road Transport," will be given by Mr. J. G. Bennett, Director, The British Coal Utilization Research Association. The Chair will be taken by the President, Colonel W. A. Bristow.

The Officials Superannuation Fund of the Liverpool Gas Company is in a very healthy state. It has investments to the value of £307,642 giving an average yield of £4 5s.%. In the year to Dec. 31, 1939, the contributions by officials on annual salary totalled £4,151, Company's contributions £6,630, and interest on investments £12,329. On the debit side were superannuation allowances of £11,045, contributions returned to officials on resignation £194, payments to representatives of deceased contributors £741, leaving a surplus of income over expenditure for the year of £11,129.

A Meeting of the Institution of Chemical Engineers will be held in the Rooms of the Geological Society, Burlington House, Piccadilly, London, W.1, on March 8, at 5.15 p.m. The following Papers will be presented at the Meeting: "Further Experiments on the Evaporation of Water from Saturated Surfaces," by Dr. R. W. Powell; and "Heat Transmission in Evaporative Condensers," by Dr. A. K. G. Thomson. Members of The Institution of Gas Engineers who are not members of the Institution of Chemical Engineers, but who would like to attend this Meeting must obtain a card of introduction. These cards may be obtained on application to either Mr. A. J. V. Underwood or Mr. M. B. Donald, The Institution of Chemical Engineers, 56, Victoria Street, S.W.1.

Up-to-Date Offices and Showrooms for Wolverhampton

This attractive new building, which was opened to the public on Feb. 26, replaces the old offices of the Wolverhampton Gas Company on the Corner of Darlington Street and Waterloo Road. It is a reinforced concrete structure, faced externally with Portland stone and black granite. The accommodation includes a large ground floor showroom and demonstration room, a basement showroom, and two floors of offices above.

THE main showroom has a green terrazzo floor, cream coloured plaster walls and ceilings, and Australian walnut woodwork. There are built in displays of gas fires and water heaters.

From the showroom, double doors lead to the Demonstration Room, which has a fully equipped stage for cookery lectures, &c. This room is panelled in walnut, with biscuit coloured plasterwork above and a brown and white rubber floor, and has three large recesses along one side for displays. Both these rooms are equipped with mechanical ventilation, fresh air being drawn in over heating elements under the shop windows and stale air extracted through grilles in the false ceiling.

In the basement is situated the showroom for canteen equipment. This room is in cream plaster with a floor of green terrazzo, the heating being from panels in the ceiling. There is also an industrial showroom. The first and second floors are devoted to offices which are well lighted by the continuous band of windows, which are such a distinctive feature of the elevation.

The Architects were Messrs. Lavender & Twentyman, of Wolverhampton, and the Contractors, Messrs. Wilson Lovatt & Sons, Ltd., also of Wolverhampton.

Salford Gas Department's New District Showrooms

The Salford Corporation Gas Department whose area of supply covers an area of 40 sq. miles, including several important urban areas outside the city, made an important move in its campaign to increase sales in its "extra territorial" districts on Feb. 23, when new Showrooms were opened in the main thoroughfares of Walkden and Eccles.

IN each case a most artistic colour scheme has been carried out, calculated to appeal to the feminine sex as potential customers. The ground floor, where the gas appliances are displayed, and where the Accounts Office is placed, as well as the second floor, where there is a small Lecture Theatre, are decorated with a delicate *eau de nil* tint, with green jasper lino, and apple-green upholstered chairs of unpolished oak.

The members of the Salford Corporation Light, Heat, and Power Committee, were represented by Councillor C. J. Townsend, J.P. (Chairman); Alderman Kearns (Deputy Chairman), and Councillor J. T. Harrison, J.P. (Deputy Mayor of Salford). There were also present Mr. F. H. Goodwin (Gas Engineer and Manager); Mr. J. E. Wakeford (Deputy Manager); Mr. R. P. MacDiarmed (Chief Administrative Assistant); and Mr. M. Severs (Showroom Superintendent).

Walkden

The party were welcomed at Walkden by Councillor A. J. Salt, J.P., Chairman of the Worsley Council.

Councillor TOWNSEND expressed the pleasure of the Corporation at the presence of the Chairman of the Worsley Council, and proceeded to deal with statements which had appeared in the Press to the effect that Salford Gas-Works would have to close down because it had no coal. That was a mistake. There was going to be a debate on the matter in Parliament, and in order that the interests of the Salford Gas Department should be safeguarded, not only were letters written to Salford M.P.'s, but telegrams were sent to them, so that they should see Salford did not run short of coal. Somebody in the House of Commons had said that the Salford Gas-Works was going to close down. That also was not a fact in any shape or form. Salford was all right in regard to a supply of gas, and they had an agreement by which they could call on Manchester and Stretford in case of emergency. There was no chance of Walkden or Worsley being short of a gas supply from Salford.

Councillor SALT, declaring the showroom open, said he was sure new enterprise would expand the use of gas. The increased use of gas was an important factor in dealing with atmospheric pollution. Local Authorities, by the control of factory chimney smoke, and the use of improved road materials, were doing much to ensure a cleaner atmosphere. The problem of smoke emission from thousands of house chimneys still remained to be solved; until something different from the raw coal system was adopted, this trouble would remain. The modern housewife, unlike her mother and grandmother, who spent, or rather wasted, much time in unnecessary cleaning, expected to have a house which was easy to keep clean. By taking advantage of the wonderful present-day gas apparatus she could reduce domestic toil, and at the same time do much to keep the atmosphere clean.

Councillor HARRISON then presented Councillor Salt with a handsome silver fountain pen, suitably inscribed, as a souvenir of the occasion.

Mr. F. H. GOODWIN said it was necessary in these days to have showrooms so that the public could inspect the latest developments in gas appliances and attend lectures with regard to their use. Very soon, he believed, in co-operation with the Board of Education, there were going to be delivered lectures on Wartime Food Economy, &c., so that the showrooms had been opened at a very opportune time. The supply of gas to Worsley for the year ended March 31, 1939, was about 61 million cu.ft., and as the Salford Corporation produced a total of 1,420 million cu.ft. per annum Worsley had quite a lot of prospective ground to make up.

Eccles

At Eccles, Councillor Townsend introduced the Mayor of Eccles, Alderman A. A. J. Trippier, who was accompanied by the Mayoress, Mrs. Trippier, to perform the opening ceremony.

Alderman TRIPPIER congratulated the Salford Gas Department for having established so attractive a showroom. Eccles had its own electricity showroom, but, in his opinion, there was room for both industries. Gas was a very valuable asset as a source of industrial power, and from the national point of view the by-products of gas were most important. The facilities afforded to the public by the new showroom would greatly benefit them. Not only was the use of gas important in the domestic sphere, but it was interesting to note that an Eccles bakery, one of the largest in the country, used gas.

Councillor HARRISON then presented the Mayor of Eccles with a suitably inscribed fountain pen.

Mr. GOODWIN spoke of the large industrial gas consumption in Eccles, and said that cheap gas by attracting industry and business could make a town more prosperous. The Local Authority, residents, and business people alike shared in the benefit accruing. Eccles consumed about 15% of the Department's total output, and topped the list, even above the city of Salford, by averaging nearly 20,000 cu.ft. per annum per consumer. In conclusion, Mr. Goodwin expressed his appreciation of the presence of the Electrical Engineers of Salford and of Eccles. He would like to put on record that their relations with both Electricity Departments were of the happiest and most friendly description. There would be no cut-throat competition between them. Their aim was to help each other.

Tea was afterwards served in the Eccles Showroom.

A Modern Service Centre at Newcastle-under-Lyme

Opportunity was taken in the erection of a modern range of shops by the Newcastle-under-Lyme Corporation to allocate two premises to the Gas Department for the provision of a new Showroom, and a very attractive service centre was opened to the public at the end of last September.

[Photographs by W. Harrison & Son, Newcastle, Staffs.

THE two shops were made into one and so laid out from the inception of the scheme as to make the premises suitable for a gas showroom. A number of "Nautilus" flues were built into one room to enable five gas fires to be shown in operation. A sixth flue was placed behind the counter for the convenience of the clerks, and other flues were installed for gas cooker alcoves and for the water heater display. What would have been the wall dividing the two shops was omitted and the building over-carried on a steel stanchion. This scheme made a roomy and very airy showroom, as will be seen from the accompanying photographs. Over the showrooms is a room extending from back to front which may be employed as a store and office or for the use of the lady demonstrator.

The original scheme of decoration was by the Nautilus Decorating Department of the Davis Gas Stove Company, and this scheme was carried out by the Corporation's own Architect in consultation with the Gas Department. Messrs. John Curtiss & Son, Ltd., of Leeds, carried out the actual work after tenders were accepted. The doors, frames, counter, and wood furniture is in Austrian oak colour, and the floor is of polished blocks. There is ample space for modern steel frame tables and chairs for the use of customers.

The range of gas fires on one side is fully shown in one of the photographs, while the water heating display embracing storage and instantaneous heaters, both single and multi-point, is shown in the other picture.

The showroom fronts on Merrial Street, while one side, in which there are two large windows, adjoins an arcade which will eventually be developed and form a connecting thoroughfare between the main shopping centre of the town and Merrial Street. On the other side of this arcade the Electricity Department have opened a showroom.

Accounts may be paid at the showroom, a facility which is taken advantage of by a large proportion of consumers; consequently they cannot help but see the latest displays of appliances. Complaints may also be notified at these premises, and as the showroom is connected by direct telephone with Head Office these can receive prompt attention. The new premises were first opened to the public on Sept. 28, but the black-out has since prevented the demonstration of the effective lighting equipment, which consists of Webson distance control, one of the switchboards of which may be seen in a photograph.

Alternative Motor Fuels

By
C. M. WALTER, D.Sc., M.Inst.Gas E., A.M.I.E.E.

From a Paper before the Royal Society of Arts on Feb. 28

AT the outset of the proceedings Lord Strabolgi presided. He paid tribute to the pioneer work at Birmingham on the use of compressed gas as a motor fuel. The use of home-produced alternatives to petrol must, he emphasized, be encouraged, and 7% of peacetime requirements could be replaced by methane alone. This encouragement should cover the alternatives dealt with by Dr. Walter in his Paper and also steam driven and electric vehicles.

In the course of his Paper, which he illustrated with lantern slides, the Author said that the optimum power output possible from an engine of a given compression ratio will follow closely the heat of combustion per unit volume of charge. Therefore the figures given in Table 1 will serve as a useful guide as to what might be expected in the way of maximum power output for a given engine in each case. In some instances where the maximum power output is insufficiently high, it may be necessary to adopt means whereby the charge weight is increased, such as supercharging or in some cases, to raise the compression ratio in order to obtain power outputs comparable with those realized with petrol or oil.

Allowing for losses during filling and other incidental losses, tests have shown that 1.3 to 1.4 therms of town gas are equivalent to one gallon of petrol. In the case of a converted petrol engine with a normal compression ratio of 5½-6½ : 1, the maximum power output obtainable with gas is approximately 85% of that of petrol. This, however, can be improved by increasing the compression ratio and resorting to new cycles, depending on fuel injection or compression ignition with a small quantity or oil as a pilot igniter.

Alternative Storage

In the present emergency it is quite possible that vehicles might be required to be equipped for operating on town gas where difficulties might be experienced owing to the difficulty of accommodating the storage cylinders and other equipment necessary. In order to meet this requirement a scheme has been introduced whereby the complete storage system, including storage bottles and first stage reducing valve, is neatly housed on a trailer which can be readily attached to the vehicle. With this arrangement fuel is supplied to the engine by means of a flexible hose fitted with suitable quick connexion adaptor. In cases where these are employed, the second stage reducing valve would be housed as near to the engine as possible.

The use of a trailer system obviously has certain disadvantages owing to the difficulty of reversing; nevertheless there are definite advantages from a point of view of operating costs. The cost of such a trailer unit would generally not be much greater than that necessary for the equipment of a vehicle with similar storage capacity.

Further, where a fleet of vehicles was operated with trailers, additional units could be kept at the charging station where they would be charged and used for replacements.

Typical examples of units of this type include three and six bottle trailers, the smaller being capable of dealing with many forms of transport for light vehicles, having a range of 40/50 miles on a single charge, and the larger unit, when employed with vehicles of capacities up to 5 tons, being capable of supplying sufficient fuel for mileages of 60/80 on a single charge.

The examples shown in Tables 2 and 3 will give some guide as to the storage and compression costs for a particular set of conditions, from which it will be noted that with gas supplied to the inlet of the compressor at 5d. per therm, the compressing costs, including all capital and power charges, would be of the order of 4.5d. to 5.5d. per equivalent gallon of petrol, and the fuel cost 7.3d. per equivalent gallon, making a total of 11.75d. to 12.75d. per equivalent gallon. To these costs would have to be added a figure to cover the charges associated with the vehicle equipment. As this will depend upon the number of charges taken per day, it is essential that wherever possible at least two charges should be arranged for, and under these conditions it is found that, in the case of a six-bottle vehicle, the corresponding equipment cost would be about 1.2d. per equivalent gallon of petrol, this figure being reduced or increased according to the number of daily charges and the number of bottles employed.

From the above it will be seen that for certain transport operations, gas at 5d. per therm could be employed at a total cost equivalent to petrol at 14.5d. to 15.5d. per equivalent gallon.

Methane and Methane Mixtures

The sources from which methane may be obtained are as follows:

1. Sludge gas from sewage.
2. Production from town gas or coke oven gas by catalytic methods. (This has been described by Messrs. Graham and Skinner in a Paper recently given before the Institute of Fuel.*)
3. Blow-holes in coal mines.

It is not surprising to find that a great deal of interest has been shown in the use of methane as an alternative fuel for motor vehicles, as it has been proved to be a very satisfactory fuel for internal combustion engines by reason of the high compression ratios which can be used owing to its low velocity of combustion. It is also exceedingly clean in use, very little carbonaceous deposits being formed in the engine.

It is well known that methane from septic tanks was used for lighting purposes in Australia and India many years ago, but perhaps its first real use as a fuel for internal combustion engines dates from 1921, when digestion tanks were employed in connexion with the treatment of sewage in Birmingham. An engine was installed, running on methane, for the generation of power at the sewage disposal works of the Birmingham Tame and Rea District Drainage Board, and this was probably the first of its kind in the world. Subsequently a much larger power unit was installed under the direction of Mr. H. C. Whitehead, M.Inst.C.E., Engineer to the Board, and the use of methane for the generation of electricity has continued to develop until, at the present time, over 4½ million units are generated annually at these works, requiring 2,400 h.p.

Further developments have taken place at Mogden, and the plant there is probably the largest in existence operated on this form of gas for the generation of electricity.

Even with demands for this purpose, a surplus is available at many sewage disposal works, which can be used as a substitute for petrol.

The approximate composition of sludge gas is methane 70% and carbon dioxide 30%. It usually contains also small quantities H_2S, which must be removed, as this and other sulphur compounds will seriously affect bottles and other equipment in storage systems.

Removal of CO_2

The major part of the CO_2 present may be removed either by chemical means or by taking advantage of the solubility of CO_2 in water. In the latter method the concentration of the methane is carried out by washing the gas under pressure, and this means the proportion of CO_2 may be reduced to 5% or less. This may readily be arranged in a system in which gas is being compressed to storage pressures of the order of 5,000 lb. per sq.in., by by-passing the second or third stages of a multi-stage compressor with a system including a washing plant, through which the sludge gas is passed prior to compression to higher pressures in the subsequent stages. The

* "GAS JOURNAL," Jan. 3, 1940, p. 39.

absorption of CO_2 depends on the pressure and the temperature, and in practice it has been found more economical to wash at higher pressure of about 19 atmospheres owing to the reduced quantity of water required.

Examples of compression and storage costs are given in Tables 4 and 5, from which it will be noted that, provided the compressing plant is run continuously for 12 hours per day, and assuming electricity is available for compressor driving at 0.4d. per unit—which is usually the case where gas driven generators operating on methane are employed—the total cost for compression and storage would be of the order of 3½d. per equivalent gallon of petrol. This figure would, of course, be reduced if the load factor could be increased. Thus, if the plant ran for 18 hours per day, the costs might be reduced to 3d. per equivalent gallon of petrol.

The chief advantage of methane from a point of view of storage over other gaseous fuels is its high thermal concentration owing to its high calorific value, and the fact that the capacity of a storage cylinder, in petrol equivalent, is increased in direct proportion to the calorific value.

A further advantage is obtained in the case of methane by reason of the fact that this gas, at high pressure does not obey Boyle's Law. At 3,000 lb. per sq.in. the product PV is decreased by 23%, representing an increase of 25% in the volume of free gas which can be stored, as compared with town gas at the same storage pressure.

Taking an ordinary standard vehicle cylinder of 1.76 cu.ft. water capacity, and using a town gas of 475 B.Th.U. per cu.ft., we find that at 3,000 lb. per sq.in. its capacity in petrol equivalent is 1.1 gallons, whereas with methane the corresponding figure is 2.85 gallons.

At the present time, while there is no accurate information available concerning the quantities of methane which may be obtainable from the various sources mentioned, there is good reason to believe that these quantities are by no means inconsiderable. The economics of the use of surplus gas under this heading would seem to indicate there should be considerable possibilities in its use for transport purposes in peacetime if provision is made for it to be readily available at conveniently placed refuelling stations.

Producer Gas

The principle made use of in the production of producer gas is much the same whatever form the producer may take, and depends upon a controlled chemical reaction between air and incandescent carbon resulting in the production of producer gas containing carbon monoxide, hydrogen, carbon dioxide, nitrogen, and—in some cases, methane, according to the type of fuel employed.

The equipment necessary for the production of this gas includes the following:

1. The producer itself, in which the gas is generated, into which the fuel is fed through a fuel hopper.
2. Means whereby the hot gas leaving the producer can be cooled to the desired temperature.
3. Scrubbers or filters which are necessary to remove very fine or suspended solid matter from the gas.
4. A control system by means of which the quantity of gas and air supplied to the engine can be regulated.

There are many distinct types of producers, sometimes described as "up-draught," "down-draught," and "cross-draught," depending on the direction in which the air meets the fuel bed. Further, in some instances water injection is employed, while in others air alone without water injection is made use of. Each type has its own particular characteristics to enable it to operate on any particular type of fuel such as low-temperature coke, anthracite, or charcoal.

The equipment referred to above can either be housed on the chassis of the vehicle itself or mounted on a trailer in the form of a self-contained unit, and where the latter system is employed, the gas is led to the engine through a quickly detachable flexible coupling pipe.

While a very wide range of fuels can be used for the production of producer gas, including low-temperature coke, anthracite, wood, charcoal, and peat coke, those most readily available in the required quantities in the United Kingdom are anthracite and low-temperature coke, and it is more particularly in connexion with these latter forms of fuel that a considerable amount of research and investigation is being done at the Fuel Research Station in order to decide what forms are most suitable, and also to ensure that sufficient quantities would be readily available.

While it is generally agreed that charcoal is one of the most suitable types of fuel for the running of producers as it has the advantage of being free from volatiles and has a very low ash content, its use in this country is restricted owing to the limited supplies available, and for this reason special attention has to be given to the low volatile anthracites and certain types of low-temperature coke which are immediately available in relatively large quantities.

A considerable amount of work has been carried out particularly in connexion with these fuels, and it is pleasing to note that arrangements are being made for larger quantities to be made available in the near future.

With regard to the performance possible with this form of fuel it would be anticipated in view of its relatively low calorific value—and it has proved to be so in practice—that when used as a fuel in a standard type of petrol engine, the maximum power output which could be obtained would perhaps amount to only 60% to 65% of that possible with petrol, and reference to Table 1 will show that this is largely as a result of the characteristics of the fuel, due to the comparatively low B.Th.U. concentration in a theoretical air/gas mixture.

Further limitations in the use of producers are due to the additional bulk and weight of the producer itself and the fact that the vehicle has to carry its own solid fuel.

Small Conversion Cost.

It would hardly be expected possible with portable producers of this type to ensure uniformity of composition of gas produced under varying conditions of operation as is possible with other alternatives such as town gas or methane where the constancy of composition is assured and is independent of the operating conditions. It must be pointed out, however, that the producer gas vehicle has one definite advantage over the alternatives previously referred to, in so far that the capital expenditure necessary for the conversion of a vehicle to operate on this principle is comparatively small. Thus as a wartime expedient there seems every possibility that this alternative might be very suitable for the running of medium weight and heavy vehicles over long distances. The extent to which it can be employed for other forms of transport will, in the Author's opinion, have to be decided on the results obtained from practical experience, but it would seem that in the case of certain types of transport in which only light loads are carried and extreme flexibility is required, other fuels might have to be resorted to.

As in the case of other gases, however, this form of fuel could be made to give improved performances provided modifications to the engine itself were carried out. In the case of producer gas, it is possible considerably to increase the maximum power output and efficiency by raising the compression ratio, in some instances up to a figure of 8—1.

With regard to fuel consumptions, while this will vary according to running conditions, figures are quoted in the Committee's Report on "The Emergency Conversion of Motor Vehicles to Producer Gas" of 1.5 to 2 lb. per mile in the case of a vehicle with a gross laden weight of 6 tons. It would also appear that on a single charge of anthracite distances from 120 to 150 miles might be covered.

In the present emergency the pooling of knowledge resulting from the investigation of all these alternatives, combined with the closest possible collaboration on the part of transport operators, engine designers, and vehicle makers, should result in each of these alternative fuels being employed for that particular form of transport for which it is suited. In order to accomplish this end, it is hoped that the encouragement which has been given by the modification of existing methods of taxation based on unladen weight, and the assurances that these fuels will not be taxed for a period of five years, will be supplemented by such further encouragements as may be necessary so far as wartime conditions will permit.

From what has been said, it will also be appreciated that the application of any of these alternatives as a wartime expedient must necessarily result in their use in a manner which cannot be expected to give optimum performances.

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Special Design of Engine Necessary.

For the most efficient results to be obtained, it is evident that in many instances special designs of engines would be necessary, and in some cases new thermodynamic cycles of operation might have to be resorted to, as for example, the adoption of fuel injection systems for gas engines, if results comparable with those obtained with liquid fuels are to be achieved.

Developments such as these could not be considered during the present emergency, but there appears to be every possibility of such modifications being made to existing engines as to enable reasonable performances to be obtained.

The disabilities of all these alternative fuels, due to greater weight and, in some cases, limitation of fuel storage, must be freely admitted when compared with petrol or petroleum products, and the extent to which they can be used to replace or supplement liquid fuels in peacetime will depend upon how far these may be compensated for or removed.

In regard to possibilities of development in peacetime, it can only be stated that for many years serious consideration has been given to the question of the extent to which certain of these fuels might prove satisfactory partially to replace or supplement petroleum products, and while it would be quite illogical to assume that any one or a combination of these indigenous fuels could entirely replace the whole of liquid fuels used in the widely different fields of transport, nevertheless as a result of experimental work which has been carried out and which will undoubtedly be continued, there seems every justification for the further development of certain of these derivatives of coal as home produced fuels for particular types of transport.

In its present form it would appear that the producer gas-operated vehicle could not be expected in peacetime to replace the petrol or oil-operated vehicle for certain types of transport which demand the greatest possible peak power outputs, maximum acceleration, and maximum flexibility, although there would appear to be considerable possibilities for the development of this type of fuel for transport work in which heavy loads have to be moved over long distances and where the load on the producer is not of an intermittent nature.

Possibility of Considerable Development.

With regard to the application of town gas, coke oven gas, methane, or sludge gas obtained from sewage disposal works, it would seem that there is every possibility of considerable developments covering a wide range of transport operations, where the limitations imposed by the increased weight are not of a serious nature. It would appear that with properly organized schemes, developments would take place first of all in localities where compressing stations were available, and that this form of fuel would be used for local deliveries and transport of goods within a limited area. Further development would then depend on the interlinking of these areas by the establishment of compressing and refuelling stations placed at intermediate points.

It would also appear that further interlinking might take place in order to make available methane as a by-product gas or sludge gas derived from sewage disposal, all of which could be dealt with at the appropriate refuelling stations.

Encouragement has already been given in the form of amendments to existing methods of taxation; these must be continued. Assurance must also be given that home-produced fuels will not be taxed. With a long-term policy based on these assurances, there will be no difficulty in justifying the capital expenditure necessary for development on the lines suggested. This must of necessity be gradual and to a great extent controlled by the rate at which the necessary compressing plant and vehicle equipment can be provided.

The Gas Industry will expand as it is found necessary to meet the demands for increased quantities of fuel, which again would be gradual, and only on lines parallel to similar expansions which have taken place in the past to meet the demands made upon it for domestic and industrial applications, particularly the latter.

It would therefore appear that no serious difficulty should be experienced in catering for the fuel requirements of such a scheme.

TABLE No. 1.

Calorific Values (Net) of Theoretical Air-Gas Mixtures for various types of Fue Gas.

Fuel Gas.	Theoretical Air-Gas Mixture. Net C.V. B.Th.U/cu. ft.
Sludge Gas (70 CH_4, 29 CO_2, 1N_2)	81.8
,, Washed (94 CH_4, 3.5 CO_2, 1.5 N_2)	84.7
Town Gas (Typical analysis)	86.7
Producer Gas (Typical analysis)	61.9
Pure Methane	85.1
,, Ethane	89.5
,, Propylene	95.9
,, Propane	91.7
Petrol (average)	102.0

TABLE No. 2.

Equivalent Costs of Compressed Town Gas and Petrol, based on the employment of Compressors having Capacities of 100 cu. ft. Free Gas per Minute to a Final Pressure of 5,000 lb. per sq. in. Gauge, which are considered to be the Smallest Permissible Economic Units.

CASE 1.

This allows for a compressing station with two such units, electrically driven, each running 18 hours per day, 6½ days per week and 52 weeks per year, with 5,000 lb. per sq. in available storage capacity for half a day's output of each machine.

Capital Charges.	£
(*a*) Two sets motor driven 100 cu. ft. per minute machines complete with switchboard, foundations pipe work and installation costs, including de-benzolizing plant	4,500
(*b*) 27 storage bottles, each of 19 cu. ft. water capacity, having a free gas capacity of 6,300 cu. ft. each at 5,000 lb. per sq. in. complete and installed	5,500
(*c*) Compressing Station, Building, and Offices	1,000
(*d*) Extras (not allowed in above)	500
	£11,500

Annual Charges.	£
(i) *Capital.*	
Interest at 5% on (*a*) + (*b*) + (*c*) + (*d*)	575
Depreciation and maintenance (*a*) at 15%	675
Depreciation and maintenance (*b*) at 10%	550
Maintenance and repairs of Buildings (*c*)	50
(ii) *Operating Costs.*	
Power Charges, 608,400 K.W. hours electricity at (say) 0.8d. per unit	2,028
Labour Charges	600
Oil waste, stores, and cooling water	150
	£4,628

Equivalent Petrol Output.

On the assumption that the equivalent of one gallon of petrol is 300 cu. ft. of de-benzolized gas (475 B.Th.U. per cu. ft.), the output of the above plant corresponds to 73,000,000 cu. ft. per annum, or 24,300 gallons.

	d.
Total costs of compressing per equivalent gallon	= 4.57
Cost of gas per equivalent gallon at (say) 5d. per therm	= 7.3
Total cost per equivalent gallon	= 11.87

TABLE No. 3.

Equivalent Costs of Compressed Town Gas and Petrol, based on the employment of Compressors having Capacities of 100 cu. ft. Free Gas per Minute to a Final Pressure of 5,000 lb. per sq. in. Gauge, which are considered to be the Smallest Permissible Economic Units.

CASE 1A.

This allows for a compressing station with two such units, electrically driven, each running 12 hours per day, 6½ days per week and 52 weeks per year, with 5,000 lb. per sq. in available storage capacity for half a day's output for each machine.

Capital Charges.	£
(*a*) Two sets motor driven 100 cu. ft. per minute machines complete with switchgear, &c.	4,500
(*b*) 18 storage bottles each of 19 cu. ft. water capacity, having a free gas capacity of 6,300 cu. ft. each at 5,000 lb. per sq. in. complete and installed	3,660
(*c*) Compressing Station, Buildings, and Offices	1,000
(*d*) Extras (not allowed for in above)	500
	£9,660

Annual Charges.	£
(i) *Capital.*	
Interest at 5% on (*a*) + (*b*) + (*c*) + (*d*)	483
Depreciation and Maintenance (*a*) at 15%	675
Depreciation and Maintenance (*b*) at 10%	366
Maintenance and Repairs of Buildings (*c*)	50
(ii) *Operating Costs.*	
Power Charges (as previously stated)	1,350
Labour Charges (assume remain as in Case 1)	600
Oil waste, stores, and cooling water	150
	£3,674

Equivalent Petrol Output.

On the assumption that one gallon of petrol is equal to 300 cu. ft. of de-benzolized gas, the output corresponds to 48,600,000 cu. ft. per annum or 162,000 gallons.

	d.
Total cost of compressing per equivalent gallon	= 5.44
Cost of gas per equivalent gallon at (say) 5d. per therm	= 7.30
Total cost per equivalent gallon	= 12.74

TABLE No. 4.

Example of Costs of Compression and Storage of Washed Sludge Gas, containing 95% Methane, based on the Use of Compressors having Capacities of 100 cu. ft. Free Gas per Minute to a Final Pressure of 5,000 lb. per sq. in. Gauge.

CASE 2.

This includes for a compressing station with two such units, electrically driven each running 18 hours per day, 6½ days per week and 52 weeks per year, with available storage capacity at 5,000 lb. per sq. in. equivalent to 9 hours output of each machine.

Capital Charges.

	£
(*a*) Two sets motor driven 100 cu. ft. per minute machines complete with switchboard, foundations, pipe work and installation costs	4,000
(*b*) 27 storage bottles each of 19 cu. ft. water capacity, having a free gas capacity of 6,300 cu. ft. each at 5,000 lb. per sq. in. complete and installed	5,500
(*c*) Washing plant and auxiliaries	3,000
(*d*) Compressing Station, buildings, and offices	1,000
(*e*) Extras (not included in above)	500
	£14,000

Annual Charges.

	£
(i) *Capital.*	
Interest at 5% on (*a*) + (*b*) + (*c*) + (*d*) + (*e*)	700
Depreciation and maintenance on (*a*) at 15%	600
Depreciation and maintenance on (*b*) at 10%	550
Maintenance and repairs on (*c*) at 7½%	225
Maintenance and repairs of buildings (*d*)	50
(ii) *Operating Costs.*	
Power charges, 725,000 K.W. hours at (say) 0.4d. per unit	1,210
Labour charges	600
Oil waste, stores, and cooling water	200
	£4,135

Equivalent Petrol Output.

On the basis of 155 cu. ft. of washed sludge gas being the equivalent of one gallon of petrol, the output of the above plant corresponds to 55,000,000 cu. ft. per annum or 355,000 gallons of petrol per annum.

Total costs of compression and storage per equivalent gallon = 2.79d.

TABLE No. 5.

Example of Costs of Compression and Storage of Washed Sludge Gas, containing 95% Methane, based on the use of Compressors having Capacities of 100 cu. ft. Free Gas per Minute to a Final Pressure of 5,000 lb. per sq. in. Gauge.

CASE 2A.

This includes for a compressing station with two such units, electrically driven, each running 12 hours per day, 6½ days per week and 52 weeks per year, with available storage capacity at 5,000 lb. per sq. in. equivalent to 6 hours output of each machine.

Capital Charges.

	£
(*a*) Two sets motor driven 100 cu. ft. per minute machines complete with switchboard, foundations, pipe work and installation costs	4,000
(*b*) 18 storage bottles, each of 19 cu. ft. water capacity, having a free gas capacity of 6,300 cu. ft. each at 5,000 lb. per sq. in. complete and installed	3,660
(*c*) Washing plant and auxiliaries	3,000
(*d*) Compressing station, buildings, and offices	1,000
(*e*) Extras (not included in above)	500
	£12,160

Annual Charges.

	£
(i) *Capital.*	
Interest at 5% on (*a*) + (*b*) + (*c*) + (*d*) + (*e*)	608
Depreciation and maintenance on (*a*) at 15%	600
Depreciation and maintenance on (*b*) at 10%	366
Maintenance and repairs on (*c*) at 7½%	225
Maintenance and repairs of buildings (*d*)	50
(ii) *Operating Costs.*	
Power charges, 485,000 K.W. hours at (say) 0.4d. per unit	807
Labour charges	600
Oil waste, stores, and cooling water	200
	£3,456

Equivalent Petrol Output.

On the basis of 155 cu. ft. of washed sludge gas being the equivalent of one gallon of petrol, the output of the above plant corresponds to 36,670,000 cu. ft per annum or 236,500 gallons of petrol per annum.

Total costs of compression and storage per equivalent gallon = 3.46d.

DISCUSSION.

Mr. **E. V. Evans,** who at the conclusion of the Paper took the chair, paid tribute to the pioneer work of Dr. Walter, who had done so much to help to advance the use of gas as a fuel for motor vehicles. In the Gas Industry the manner in which gas should be used was a matter of contention. There were two schools of thought—one which favoured compressed gas giving a vehicle mileage range of about 80, and the other which, in view of the high capital cost of the necessary equipment and the difficulty of obtaining bottles and compressing plant, favoured the use of gas at low pressure. The Author had spoken of the need for removing sulphur compounds from the gas. It might be necessary to remove the sulphuretted hydrogen, but there did not appear to be direct evidence that the other sulphur compounds in the gas would have an adverse effect on the bottles.

Captain **W. H. Cadman** said he had followed the subject of the use of fuels alternative to petrol for several years. He had known Dr. Walter for a long time and had great admiration for the work he had carried out at Birmingham. The speaker asked the Author whether a safety factor of 1,500 lb. per sq. in. for the cylinders was not on the high side, and also whether, in the event of a collision and the breaking of the bottles, the gas would be liable to ignite. He mentioned his experience of compressed gas vehicles in France. From the St. Etienne gas-works he had travelled 75 miles in a gas driven bus, the average speed over the journey being 35 m.p.h. Refuelling was carried out at a most efficient municipal compressor station. The Gas Industry of this country should become acquainted with this garage, where he had seen 30 vehicles being recharged at a time; and the time taken for a large vehicle was no more than would have been needed for refuelling with petrol.

Dr. **D. T. Davis** (Fuel Research Station) congratulated the Author on the admirable balance he had preserved in his Paper. He went on to say that the development of the producer was only one part of the problem which was being tackled at the Fuel Research Station. The success of producer gas-driven vehicles depended on the use and availability of suitable fuels, and work at the Station included investigation aimed at widening the range of suitable fuels. In this investigation they were collaborating with gas undertakings, for it was considered that neither anthracite nor low-temperature coke could fill the requirements of any real emergency. They had every hope of producing suitable fuels by high-temperature carbonization as practised at gas-works, with, maybe, a slight reduction in temperature and slight modification in technique, and with the exercise of care in the selection of coals. The fuel produced would have a premium value, and its production was therefore a good proposition for the Gas Industry. The producer fuel problem would be solved if the experiments proved successful; and, as he had said, they had every hope that success would attend the investigation.

Great Influence on Coal Industry.

Mr. **R. D. Hardy** said that development of the producer gas driven vehicle would have a great influence on the coal industry. Anthracite was needed for export, and coking coals should be used for the making of coke. But 80,000,000 to 100,000,000 tons of non-coking coal was being mined annually, and in its small sizes had to be sold at unremunerative prices. A year or so ago, for instance, there was about a million tons in stock in Leicester, a million tons in the North-East coast area; half-a-million tons in Scotland. And this small coal would fetch only about 2s. 6d. or 3s. a ton. This non-coking coal could, however, be used for gas producer work better than any other form of coal. There was no tar in the product from properly carbonized non-coking coals. The gas producer business, he concluded, had come to stay, and he knew of one firm which, as a beginning, had commenced work on 900 producers.

Mr. **John Roberts** remarked that, according to Dr. Walter, the ideal fuel for producers was charcoal, but that its supply was limited. Actually more charcoal was available in this country than was realized. All their cannels gave on carbonization a residue which could hardly be distinguished from charcoal. One cannel coal which he had investigated had an ash content of 2% and gave an ideal char, and the cannel coke manufactured at the Granton Works of the Edinburgh Gas Department made a better producer fuel than did ordinary coke. He was sure they ought to pay more attention to low-ash cannel coals.

Mr. **Scott** (Cadbury Brothers) spoke of his favourable experience with compressed gas for motor vehicles and mentioned that his firm would soon have five vehicles running on compressed gas. He thought that for short range work with frequent stops, compressed gas was the right fuel, and that for long runs with heavy vehicles producer gas showed to advantage. In any case they needed compressor plants on the main arterial roads.

Sir **Alexander Walker** said the country could not afford to import so much oil and it could not afford not to act in this matter of employing alternative fuels for transport. He emphasized the advantages of the electrically propelled vehicle. He had one eighteen years ago and it was "still going strong;" it had needed no repairs, and depreciation was very small, and he felt that electricity was the future prime mover for urban transport work. Compressed gas came into what he would term the intermediate range, while producer gas could cover a different and wider range. The practical development work ought to have been done 10 years ago. If to-day the Government would give priority to steel for the making of compressors and bottles it would find this less expensive than giving priority to steel for making tanks to replace those lost in bringing oil to this country.

Mr. **Evans,** in thanking Dr. Walter for his Paper, said he would like to see the Author's work crowned with success.

Dr. **Walter,** replying to the discussion, remarked that at the present time it was not a question of competition among fuels alternative to petrol for motor transport; it was a question of getting a move on. In answer to Captain Cadman, work on the bursting strength of bottles had been carried out 10 years ago in which he had had the valuable assistance of Colonel Thomas, of the Home Office; and this work showed that the pressures at which the vessels broke down corresponded to the theoretical estimations. As to fire risk with compressed gas in the event of cylinder breakage, this was small because of the high velocity at which the gas would issue from the cylinder. He was glad that fuels suitable for producer-gas driven vehicles were being investigated, and he hoped the work would meet with the success anticipated by Dr. Davis. Finally he would like to pay tribute to the sympathy which Sir Alexander Walker had for so many years shown in the experiments carried out on compressed gas at Birmingham.

Modern Gas Storage

From a Paper to the Institute of Fuel, Feb. 22

By
S. CLAYTON THOMSON

IN the years just preceding the Great War, an idea was conceived which broke away from tradition—that of a gasholder being constructed without the necessity of water or tank; and in 1918 the baby was born when the first of the type of M.A.N. construction was erected in Germany, prototype of the modern giants which are becoming quite a common feature upon the industrial landscape to-day.

The idea was developed by two German firms—the M.A.N. Company, of Nuremburg, and the Klonne Company, of Dortmund. Both worked from the basic principle of a cylinder inside which is located a piston which floats upon the gas stored underneath it, and great advantages were claimed over the water-seal type.

As already stated, the gasholder tank was dispensed with, and thus dry storage was assured with all the advantages that this brings, such as dry gas, no risk of water freezing in winter, no bacterial trouble in the tank water, no corrosion of the steelwork, and, at one and the same time, a cleaner job and less painting to be carried out.

The load on the gasholder foundation was greatly reduced by the absence of the tank water, allowing for lighter foundations, and installations could be made on poor ground with comparative ease. Further, the absence of tank and telescopic shells resulted in two distinct advantages. First, the saving in ground area required for the storage of a given volume of gas and, secondly, an almost constant gas pressure was assured. Also, if extra storage capacity was required, enlarging would be a simple matter; it could be done with gas in if necessary, and should the foundations sink through any cause, re-levelling would be easy.

To a gas-works the absence of water troubles and the steady gas pressure are a great boon, but more especially can one see the application of these advantages on a coke oven plant where the gas is required for works services and other supplies. The holder is used as a governor, giving such a pressure as is necessary to fulfil all requirements without the aid of a booster. There are no corrosion troubles due to the unpurified gas, and at weekends it may be filled to capacity, doing away with the necessity of bleeding the excess gas due to the slackening down of the works requirements on the Sunday.

In the case of blast furnaces, the waterless gasholder can take care of the very large and sudden changes of gas flow which take place (the piston moving very quickly), and will allow a furnace to be out of action for half an hour or so for minor repairs or adjustments, without the effect of this being felt by the services relying upon the gas. The dust and other impurities in the gas are also well taken care of, and do not affect the holder in any way.

The virtue of being free from corrosion is a most important one where the storage of crude and corrosive gases is concerned, as all who have had to deal with such gases in water-seal holders will bear out. Cases have been known of water-seal holders being unfit for use after eight or nine years' working, due to severe internal corrosion caused by the crude gas stored, and in others heavy corrosion has been caused by the water becoming affected by bad atmospheric conditions, the water taking impurities from the air, the resulting weak acid solution attacking the metal.

Thus the basic ideas and advantages of the two types of waterless gasholder are seen; but here the similarity ends, for while the M.A.N. Company concentrated upon a design giving a polygonal shape to the cylinder and piston, and used a liquid seal, the Klonne Company designed a gasholder having a circular cylinder and piston and relied upon a dry seal.

High-Pressure Gasholders

Another type of "dry" gasholder to make its appearance within the past 20 years is the high-pressure type, but it comes in a different category from all others, being their antithesis in that it has constant volume while the pressure varies. It cannot, on its own, accommodate itself to the amount of gas to be stored, but requires other plant, such as compressors and pressure-reducing valves, and a self-regulating holder from which the gas is pumped.

There are two types—spherical and lozenge shape—the former, of course, being the more perfect type for high-pressure work.

They are, however, limited to size, and with few exceptions are well under 250,000 cu.ft. capacity. There is a spherical holder of 700,000 cu.ft. capacity in Ostend, about 62 ft. in diameter, and working at six atmospheres; and in America there are a number of bullet-type holders of about 500,000 cu.ft. capacity. But one can say these are exceptions at present and are well above the maximum size encountered in this country.

It is true that these high-pressure holders have certain advantages over other types, in that they have no working parts, no liquid seal, are easy to paint, and the foundations are small; they also combine well with high-pressure distribution. And when a new system is installed entailing the distribution of gas over wide areas of country covering many square miles, the high-pressure system of distribution and storage can be adopted to advantage.

Thus many examples of this type can be found in America, where gas is sometimes transmitted vast distances from natural gas sources, holders being placed at convenient locations for distribution to the consumer. We in Britain have commenced installing such systems, but it remains to be seen whether this trend of development is going to prove really popular.

Despite the fact that in themselves they are reasonably inexpensive and require small foundations, when all is taken into account in normal circumstances it is generally found that other types are more economical for any holder of fair size, and their use, as previously stated, is confined mainly to installations for outlying districts which are supplied by small high-pressure mains.

Installation of a Coke Oven Gasholder

In the case of the 2,000,000 cu.ft. capacity M.A.N. gasholder described by the Author, all the assets of a waterless gasholder are shown to advantage.

In the first place the foundations and their location had to be considered. The only available space for the gasholder was reclaimed land—land which was originally a mangrove swamp on the borders of a river. Water was reached 5 ft. or 6 ft. below ground level, and piling was necessary even for the light loads thrown by the gasholder. The total load was 2,740 tons, including wind load, structure and ballast, foundations and earth, giving a maximum load per bay at the shell base of 137 tons, or 1.13 tons per sq.ft. The maximum loading of the slab was 100 lb. per sq.ft. If the weight of the structure alone was taken into account and compared with that of a water-seal holder of similar capacity, it would be found that whereas the waterless holder weight was 1,200 tons, that of a column-guided water-seal holder would have been 18,700 tons, made up of the holder and tank 1,700 tons and water 17,000 tons—or nearly 16 times as great. If a spiral holder had been adopted, the total weight would have been 300 tons less.

Further, it is probable that in addition to a fairly heavy reinforced concrete slab, about 700 to 800 piles would have had to have been driven to support it, which is excessive and in no way compares with 161 driven for the waterless holder.

It is readily understood that a very great saving in cost is effected by the adoption of the latter type, in addition to the saving in ground area.

The waterless holder is 123 ft. 9 in. diameter, whereas a four-lift water-seal holder would be 154 ft. diameter, giving equivalent concrete areas of 16,000 sq.ft. and 24,000 sq.ft.

Keeping to the same train of thought—the weight involved of the structure—yet another advantage was provided by the installation of the waterless gasholder. Should the ground behave treacherously and cause an uneven settlement of the foundations and holder, it would be a comparatively simple matter to lift and level up the holder without disturbing its working to any great extent. Or should the settlement be slight, the piston levels would soon be adjusted by manipulation of the 40 guide rollers. But had a water-seal holder been adopted, the tank would have to be emptied of water for any serious settlement before levelling up could be done, and even though it might be overcome by resetting the carriages, there would be some 240 guide rollers to attend to in a standard-guided holder, or 88 in a spiral holder.

The structural problem being thus settled, the gas to be stored received attention, and again the M.A.N. holder scored heavily. It is debenzolized unpurified coke oven gas, fully saturated, contains 130 grains per 100 cu.ft. of H_2S at N.T.P., and 40 grains per 100 cu.ft. of naphthalene.

It is used for works heating purposes, the maximum production from the coke ovens being 1,110,000 cu.ft. per hour.

With such high percentages of impurities in the gas serious trouble would soon be experienced with a water-seal holder working in the rather trying atmospheric conditions. The average temperature is 72° F., the variation being from 40° F. to 100° F. to 110° F. in the summer. In such temperatures the inside of the gasholder would always be humid with moisture running down the gasholder sides, and the high proportion of H_2S present would react under these favourable conditions to cause heavy internal corrosion. This would be exceedingly severe on the sunny side of the holder, due to evaporation and the aid rendered to the reaction by heat.

The high naphthalene content of the gas would also be a source of trouble. A sudden cooling of the gas would take place upon it passing through the inlet pipes in the tank, resulting in the naphthalene being deposited in the pipe, eventually causing a restriction there.

There would be no such troubles with a waterless holder. In fact, as far as internal corrosion is concerned, the tar which is constantly passing down the sides effects a perfect protection, and, furthermore, the gas is kept dry.

Finally, the gas pressure required and the rate of gas flow were both against the adoption of a water-seal holder. A working pressure of 20 in. was required, involving still higher maximum pressures if the holder capacity was to be used to anywhere near its full extent.

Inconvenient drops of pressure amounting to 3 in. each time a lift is uncupped would be encountered, and the rate of gas flow might cause cup troubles at such periods. From a structural point of view, too, the scheme would not be very sound, due to the extremely deep cups and dips involved and the amount of pressure weights entailed. These would exceed the total weight of all the lifts.

The gas pressure at the outlet of the waterless holder only varies 1¼ in., this being due to the change in height of the gas column, the greatest pressure being when the piston is at its lowest position. Speeds of piston travel up to 5 ft. per minute can be attained for very short periods, though a maximum of 3 ft. to 4 ft. per minute is recommended, all depending a good deal upon the state of the sealing medium.

Operation

With such conditions it was obvious that an M.A.N. gasholder should be installed, and in operation it has functioned extremely well.

The pump runs have varied from extremes of 11 runs each to one run each, depending upon the atmospheric temperature, the average runs per pump per day being about four and a half. This reasonably low figure has ensured that the sealing medium gets ample time in which to give up the entrained water in the separating chambers, and it can be assumed that it makes a complete circuit of the system in from 8 to 12 days, depending upon the atmospheric conditions.

The depth of the sealing medium in the seal has not varied above 1 in., and the piston averages about ½ in. out of level, a satisfactory figure considering it is carrying 400 tons of pressure weights.

It is interesting to note that the greatest variation of levels occur when the temperatures are high, denoting a higher expansion of the shell than the piston which it houses. This expansion occurs for the greater part on the sunny side of the holder, temperatures of anything up to 150° F. being met with on the shell sides; thus one can presume an uneven expansion of the shell, little taking place on the shaded side, and accounting, as much as anything, for the varying piston levels.

The sun also has its effect upon the sealing medium circulation system, the medium on the sunny side being always more fluid than that on the other side. This is especially noticeable during the winter months, for then the usual conditions are that of a cold wind blowing on the shaded side, the sunny side being sheltered from the wind. The result is a big temperature difference between the two sides, and adjustments were made to the overflows when the holder was put into commission to ensure that the sealing medium was distributed more or less evenly over the whole of the system.

The Future?

The installation of a modern gasholder has been shown. What of the future? Already a new development has made its appearance in M.A.N. design—namely, the "dropped deck" piston. This is so designed that the piston deck rests upon the gasholder bottom when at rest, the seal being lifted above the deck level. By this arrangement the seal and trough are made more accessible, the piston is given a lower centre of gravity and is therefore made more stable, and there is no dead space between the piston deck and the shell bottom when the piston is landed—a great asset in an emergency when it is necessary to clear the holder of gas as soon as possible. Also when extremely corrosive gas is stored, the shell bottom can be flooded with oil, and the piston deck dipped in this at regular intervals to give a preserving coat of oil to the underside.

Further types of dry storage have been tried—steel gasholders which breathe, collapsing and inflating as the case may be, and others are probably in the minds of inventors. Much depends upon the outcome of the present troubles which beset the world; but one can say that gas will continue to burn with as bright a flame of life as in the past, and storage problems will advance with it.

DISCUSSION

The **Chairman** (Mr. F. M. Birks, of the Gas Light and Coke Company) said he was somewhat disappointed that the Author had not made more of the spiral holder, as this design was so essentially British—even more so than the column-guided holder, which, though the original designs emanated from here, every country in the world had copied and could build. The same applied to the waterless holder, whereas there had been very few examples of the spiral-guided holder outside the United Kingdom or Colonies. It might be that the inherent skill of the British workman was necessary for a structure which required such a high standard of workmanship.

Some years ago, went on Mr. Birks, he would have agreed with the Author in saying that he regarded the waterless holder as having some advantage in the storing of dry gas; but subsequent experience had proved that the drying of gas was advisable on the outlet of the holder, as storage in wet holders greatly facilitated the elimination of gum, while storage of gas in district holders of the water-sealed type provided with a thin oil film presented no difficulty whatever. Nor did he consider that in the normal temperatures experienced in this country at least the freezing of water in the seals of a holder presented any great difficulty if an ample steam supply was provided, together with a properly designed and adequate anti-freezing device.

He agreed, however, with Mr. Thomson that the absence of bacterial trouble in the tank water was a definite advantage, but he was somewhat doubtful as to the conclusion drawn with regard to the corrosion of steelwork. The subject had been very carefully studied by the Gasholder Committee of The Institution of Gas Engineers, and the conclusion arrived at was that internal corrosion was almost entirely due to the presence of a relatively large percentage of oxygen in the gas. Though he confessed he had little or no experience of storing crude coal gas, he would not have expected it to be highly corrosive provided that the interior of the holder, which was not protected by a film of tar, would not be attacked. Perhaps the Author had some information on the matter, because he had stressed in the Paper that a new design was in process of evolution where the piston would be dropped into oil in order to prevent the possibility of corrosion.

Mr. **Thomson** agreed that the spiral holder was peculiarly British. Indeed, outside this country he knew of only two others which had considered them seriously—namely, Australia and New Zealand. There were only one or two in Canada. He had stressed the advantages of this type of holder in the Paper. But the design must be good or they would have endless trouble and repairs would cost a good deal more than the column-guided type. He thought that was the reason why many engineers still preferred the column-guided type, because they had possibly heard of troubles with spiral holders which had not been designed as well as they might have been. With regard to corrosion, Mr. Thomson observed that he had not experienced any trouble from this source in gas-works holders as a result of any quality of the gas itself. On coke ovens and steel works, on the other hand, there had been serious corrosion due to the gas being unpurified. He had seen a number of holders which had completely corroded through the sides as a result of internal impurities in the gas on such plants. Only a few days previously he had seen a holder which had been in use for 30 years with coal gas with no trouble at all; but, during the last six years it had been used for blue water gas storage, and very serious corrosion had set in. The trouble had occurred below the water line, and the engineer in charge was convinced that this was due to the change-over from coal gas to water gas. So far as corrosion in a waterless gasholder was concerned, the only place where this could occur was the under-side of the piston. But this was always well tarred or painted and had little or no contact with water. Consequently, there should not be much deterioration. In one waterless holder opened up for the first time in ten years the paintwork on the under-side of the piston was found to be in quite good condition, though it had been storing crude coke oven gas.

Comparisons with Water-Seal Holders

Mr. **S. M. Milbourne** said that a careful analysis of Mr. Thomson's Paper disclosed that he had brought out very prominently all the advantages of the M.A.N. type of holder and what he considered to be the disadvantages of the water-sealed type. In this respect Mr. Milbourne thought he had dealt somewhat unfairly with the subject of his Paper, as the advantages of the water-sealed holder should be given, together with the disadvantages of the dry-sealed holder, in order that comparison might be made. For instance, it was stated that cases had been known where water-sealed holders were unfit for use after only eight or nine years' working; but no mention was made of cases where M.A.N. holders had been put out of commission for some weeks so that the canvas seal might be renewed after only a few years' working. There was unquestionably a large number of water-sealed holders in operation, and many had been in continuous use for well over thirty years. Would the canvas seal of a waterless holder last this length of time? This brought Mr. Milbourne to another important point—how was the canvas apron inspected while the holder was in commission?

The statement that there was less painting to be carried out needed qualification. If this was intended to imply that there was less area to paint in the case of a waterless holder as compared with a spirally-guided one of the same capacity, then that statement was incorrect. On the other hand, if Mr. Thomson was alluding to the number of times the M.A.N. holder had to be painted, then Mr. Milbourne submitted that the cost of upkeep was no greater in the case of a spirally-guided holder than for the waterless type; and where spiral holders had been designed for oil-filming, the periodical cost of painting was definitely much less.

Mention was made that if the correct sealing medium was used no auxiliary plant whatever was required for re-conditioning the fluid. Was not de-watering apparatus auxiliary plant? If only rare and minor attention was required to keep the sealing fluid in its original state, it would appear that tests would require to be made from time to time to ensure that the consistency of the fluid was kept within certain limits. Having regard to the many factors influencing the liquid it would seem that a close watch would have to be given by maintenance men to the performance of this type of holder.

Liability to Freeze

A reference had been made to the fact that one of the advantages was that there was no risk of water freezing in winter. If, however, a de-watering apparatus was necessary to deal with the liquid which ran from the seal, it would appear that extremely cold weather might cause a stiffening or even freezing of the sealing medium as it ran down the mantle plates. This might have a serious effect on the working of the piston. So far as ground space was concerned, the Klönne or M.A.N. type of holder certainly had advantages; but it was quite a mistake to assume that on poor ground only a flat slab of concrete would be necessary to carry the weight of a dry gasholder. The wind pressure transmitted through the sides of the holder to the periphery of the foundation was much more pronounced than in the case of a water-sealed holder of the same capacity, and for this reason it was generally necessary to extend the foundations at the periphery to a depth of several feet below ground in order to ensure a proper degree of stability. Mr. Milbourne merely mentioned this point as some engineers might be under the impression that a comparatively light slab foundation was all that was required for a waterless holder. There was no doubt that in some instances a saving in cost of foundations might be effected by the adoption of a M.A.N. holder; but it would be interesting to know if this saving was completely offset by the comparatively high cost of maintenance, including pumping, re-conditioning of the sealing medium, frequent inspection, &c.

Dry gas could now be stored in a water-sealed holder, so that this feature no longer constituted an advantage for the dry-sealed type. Mr. Milbourne took exception to the statement that lack of liquid seal such as possessed by the M.A.N. type of holder had been a deterrent to the Klönne holder being more widely used. He would point out that the Klönne holder was of later origin than the M.A.N. holder, and it had made very rapid progress largely on account of the fact that it had no liquid seal. During the few years in which the Klönne holder had been exploited it had proved increasingly popular in cases where a waterless holder was required, and it was significant that the largest waterless holder in the world—at Gelsenkirchen, in the Ruhr district of Germany—was of the Klönne type and had a capacity of 21 million cu.ft.

During the war period, Mr. Milbourne concluded, the progress of the dry-sealed holder in this country was likely to be somewhat curtailed, and it was his opinion that in the majority of cases the spiral holder would be found the most suitable type for storing gas, not only during wartime but in times of peace. This was confirmed by the very large number of holders of the spiral type that had been erected in recent years and the fact that this form of holder was becoming increasingly popular—although there were other forms of storage from which to choose.

Mr. **Toogood** said that the question of safety was uppermost in all their minds in connexion with the waterless gasholder, and asked what provisions were made for increasing the safety of such holders.

An Excellent Type of Spiral Holder

Dr. **G. W. Anderson** (Gas Light and Coke Company) remarked that there was an excellent type of spirally-guided gasholder in this country which was outstanding and which deserved a great deal more attention than it had received. It was the 12 million cu.ft. holder at East Greenwich, and it was singular from the points of view of design and performance. The bracing was in bold diagonals, and all forces were taken right back to the foundations, with cross bracing as well, of course. The bracings were very heavy, and the holder had stood for thirty or forty years and showed very little sign of age, in spite of the fact that during the last war a part of the holder was damaged by a fragment of shell or other missile.

It was open to debate as to which type of holder was the best. No doubt one type found favour with some people and another type was favoured by others; but, having had some experience of all types of holders, he ventured to suggest that the waterless holder, being a delicate piece of mechanism, required more attention than any other type. That was a very broad statement, but it was borne out by the recommendations made by The Institution of Gas Engineers, in connexion with which Mr. Birks had played a very large part.

He had been very glad to note from the Paper that some attempt was being made to lower the centre of gravity of the piston in the waterless holder, because the lack of stability of that piston was an everlasting source of danger, so that daily, or one might almost say hourly, control and attention were necessary. Again, the problem of the sealing medium had received constant attention. The maintenance of the proper consistency of oil throughout the various changes of season was very important, and in that connexion, although he had had no experience of dirty or dust-laden gas in holders, he ventured to submit that the presence of dust would interfere very seriously with the consistency of the sealing medium, so that frequent changes might be necessary. He asked if the Author could say from his own experience what that really meant.

Looking ahead, he personally visualized the probable manufacture of gas under pressure in the distant future; or, if the gas were not manufactured under pressure conditions, the purification of gas was likely to be carried out at elevated pressures, as, for instance, 10 or 20 atmospheres.

Therefore, it was likely that future gasholders would be of the pressure type, of which they knew little at the moment. Admittedly some holders of the pressure type were in use in America, and there were some in this country. Some of them had not been so successful as had been hoped. But one must always reckon with early failures. There was always a right and a wrong way of putting in a plate, and sometimes a designer had not considered fully the conditions of the inflated and the empty holder; unless proper safeguards were provided in that respect, the seams were

likely to be subjected to the wrong stress and would spring leaks, so that they needed constant attention. Finally, Dr. Anderson shared with the Chairman the hope that more papers would be forthcoming on gasholder design, whether of one type or the other.

Piston Speed

Mr. **L. Silver** (Gas Light and Coke Company) referred to the Author's statement that, in the waterless type of holder described, piston speeds up to 5 ft. per minute might be obtained. This was no doubt easily and safely possible, but the Author went on to recommend a maximum of 3 ft. to 4 ft. per minute for normal working, depending on the state of the sealing medium. This might be quite satisfactory for holders under the conditions of climate and environment the Author had described, but in gas-works in this country, situated in built-up areas, and subject to very wide temperature variations with occasional very severe weather conditions in winter, he thought a rather more cautious procedure was called for.

It was realized that the flow of sealing medium through the seal and down the walls of the holder depended on its viscosity. If this was low the number of pump runs became excessive. Also, volatility was, to some extent, associated with low viscosity, and the loss of sealing medium by evaporation to the gas might become excessive. Too low viscosity should, therefore, be avoided. On the other hand, high viscosity in the sealing medium might lead to another kind of difficulty. When the piston was falling, a film or layer of sealing medium was left behind on the walls of the holder. The thickness of this layer depended on, and might be calculated from, the viscosity of the medium under the prevailing temperature conditions, and the rate of descent of the piston. The faster the descent and the more viscous the medium, the thicker was the layer left behind. Thus during the descent of the piston the volume of medium contained in the seal was depleted, and, if care was not exercised, might be totally exhausted.

A formula had been derived for the calculation of the volume lost by the seal from the viscosity of the medium and the rate and total height of the descent. The risk of emptying the seal was greatest during spells of very severe weather, for then, not only was the viscosity of the medium greatest, but the demand for gas was at its highest, so that it was necessary to supply gas to the district at the maximum possible rate.

The Company in which he served, said Mr. Silver, employed a number of waterless holders, and it was the practice not to exceed an average rate of piston fall of 9 in. per minute for a descent extending over three-quarters of the height of the holder. Bearing this rate in mind a schedule had been set for each holder, fixing for every month of the year a maximum viscosity which must not be exceeded, this figure in each case being based on the capacity of the seal, the total height through which the piston might descend, and the maximum atmospheric temperature to be expected during the month. The viscosity was controlled by the addition of a suitable solvent of low volatility. With such high rates of piston movement as the Author recommended much lower viscosities must be employed with consequent greater loss of sealing medium by evaporation and increased cost of pump operation.

Petroleum as Sealing Medium

Capt. **W. H. Cadman** asked whether any tests had been carried out with petroleum oil as the sealing medium because it seemed to him that its use might be advantageous, particularly in regard to obtaining the right degree of viscosity. He also enquired whether the Gas Industry had adopted in any shape or form the Wiggins floating roof type of holder which was used in the United States for petroleum storage where the vapours made it essential to have some sort of breathing arrangement to provide for fluctuations in temperature.

Mr. **J. W. Martin** observed that limitation of size was an essential point with regard to high-pressure holders, 700,000 cu.ft. of releasable gas being a reasonable capacity. In one such spherical holder they started with a tripod on the outside. It was a contradiction of terms to adopt internal supports. He had been very struck by the lightness of the seal in connexion with the Wiggins floating roof holder. The seal in the M.A.N. holder was similar to that in the Wiggins holder. In the latter case he understood that the joint was not done by sail makers but by special compounds which were probably more suitable. In both cases it was usually necessary for the flexible material to be vapour-tight.

Mr. **E. A. Harmes** (Brighton) said that with regard to corrosion on the wind and water line on guide-framed holders he had taken several tests of the water in the cups where the rivet heads had been considerably corroded, but the source of the trouble appeared to be sulphur trioxide. They had examined the insides of many holders, and on one which had been at work for 45 years he had found the marks of the original erectors on the plates, while a certain amount of cyanogen was adhering to the sides.

Mr. **P. A. Andrews** (Power Gas Corporation, Ltd.), said a previous speaker had referred to the centre of gravity of the piston. It seemed to him that if instead of being flat the piston were domed that would raise the centre of pressure. He asked if the holder was tested before lowering.

Mr. Langford, in reply to the point regarding the use of petroleum as a sealing medium, said he had been associated with negotiations in that connexion, and experiments were carried out in an endeavour to find an alternative to tar. It was found that these experiments could not be brought to a successful conclusion. The fact was that they could not reach the required specification, while the price would also be twice that of tar.

Mr. **R. M. Busbridge** asked whether in the waterless gasholders any special means were adopted to adjust the piston guide rollers. This appeared to him to be a very critical operation to ensure the piston working level, particularly as the shell was very sensitive to changes in atmospheric temperature. He wondered whether the shell would be more flexible in the middle than at the top and bottom. This also would have a bearing on the roller adjustment and piston tilt. The Author stated said Mr. Busbridge, that in the coke oven gasholder described the piston averaged only ½ in. out of level. Was this to be attributed to the tightness of the rollers? If so, he wondered whether this would not lead to over-stressing of the shell and piston framing. He went on to ask whether the Author could state the type of jointing material used for the horizontal joints in the shell plates and for the plate joints to the columns, and whether the sealing medium had any affect on the jointing material which might cause tar leakage to the outside of the holder.

Re-Levelling of Holders

Mr. **W. H. White** said he would appreciate any detailed information which the Author could give regarding the re-levelling and readjustment of a waterless holder where uneven settlement of the foundations had occurred, particularly with reference to the behaviour of the radial rollers, tangential guides, subsequent piston tilts, and effects of distortion and wracking of the structure. Considering the large contact area of the sealing medium with the sides of the holder, Mr. White said it was doubtful whether the additional insulation due to a timber roof over the steel roof was of much value, particularly with regard to the weather side of the holder where the chilling effect on the sealing medium would be of a high order.

It was presumed that Mr. Thomson would advocate the use of auxiliary re-conditioning plant for the sealing medium in cases where excess dust was present in the gas—*e.g.*, in producer gas. The Author had stated that if the correct sealing medium was used it was not necessary to have a re-condjtioning plant. Mr. White also enquired what arrangements were made to reinflate a waterless holder, because under normal conditions when once the piston was landed and sealed in the oil it would be impossible to inflate the holder. With regard to facilities for purging, gas sampling, and holder water treatment, in connexion with waterless or telescopic holders, it would be very helpful if designers would arrange to fit compensating pads or plates at certain predetermined positions on the side or crown. Such pads or plates could be drilled, tapped, plugged with either a sealed valve or plug, and could be riveted or welded in position. The ease of sampling, &c., would, he was sure, be much appreciated by works chemists.

Mr. **Clayton Thomson,** replying to some of the points raised in the discussion, observed that many of the suggestions reverted to the type of sealing medium. It could not in any sense be regarded as ordinary tar. He had not encountered any cases of deterioration of the tar when waterless holders were put out of commission. The tar was of such a nature that it would not dry up completely. He could only refer those questions to the Paper, where he had stated what was required of the tar—and they had a tar which would practically fulfil those requirements. In a blast-furnace gasholder of which he knew the tar, after ten years' use, was found to be in almost as good condition as when it was put in; and it had only had periodical additions of thinning oil. They had had many similar cases of other holders where the tar was in as good a state as when it was put in. Mr. Thomson intimated that he would deal with the remaining points in writing.

Aid to Fuel Conservation

Dr. **G. E. Foxwell** submitted a written contribution to the discussion, in which he stated: The justification for this Paper is that the gasholder, which on paper appears to represent considerable capital expense for the convenience of storing gas, is actually an essential aid to fuel conservation of the highest value. This is probably more evident in the Gas Industry than in the coke oven industry. The daily fluctuations of demand are taken up by the holder that would otherwise require carbonizing plant to be kept under fire sufficient in capacity to deal with the maximum load likely to be encountered over a short period measured in minutes. The fuel necessary for keeping these retorts hot and the wear and tear on the retorts are common knowledge. The gasholder cannot give insurance against difficulties caused by a prolonged cold spell, but it is a valuable aid to fuel conservation in the insurance

that it gives against a temporary sudden demand for gas lasting, as it so frequently does in this country, for a day or two only. The alleged expense of the gas storage plant when balanced against the cost of gas-making without it, or with inadequate storage capacity, will be found to be illusory, and in fact the apparent expense of the gasholder will be found just as much an aid to efficiency as, let us say, the waste heat boiler. It may not be out of place to recall the words of an authority on the subject: "The maximum 24-hour demand represents the maximum storage usually required; and with elastic gas-making plant, 18 hours maximum demand storage is necessary. Many undertakings have worked with from 12 to 16 hours storage, though often at the expense of higher manufacturing costs." There are gas-making systems which require little or no storage, but these systems invariably produce gas of low calorific value. I believe the Mond Gas Company has no holders, but here the plant is flexible and the load, being primarily industrial, fluctuates according to a known cycle not dependent on the weather.

The subject of gasholder corrosion has been referred to both in the Paper and in the discussion. The Author states that "cases have been known of water-sealed holders being unfit for use after eight or nine years' working, due to severe internal corrosion caused by the crude gas stored." These, I understand, are holders at coke oven plants. I feel that the phrase "caused by the crude gas stored" demands further enquiry. We have come to associate "crude gas" with the presence of H_2S, and purified gas with the absence of H_2S. Is there any evidence that H_2S is a corrosive agent? The coke oven industry has not had holders in operation for a sufficient time for their life to be measured by the standards of the Gas Industry, but many small balancing holders that have had crude gas in them day in and day out have been in operation without corrosion for a number of years. The corrosive agent is obviously not CO_2, for this gas is stored in holders in the pure state in the chemical industry, and moreover purified coal gas will contain perhaps 2% to 5% of CO_2. The conclusion from numerous experiences seems to be inescapable that oxygen is the governing factor.

Many discoveries have been made of recent years upon the mechanism of the corrosion of iron and steel, but it remains true as it did in Newton Friend's day that corrosion of steel can be caused by $O_2+CO_2+H_2O$. The uncertainty arises from the fact that one does not appear to get corrosion with a gas containing perhaps 1% of O_2 arising from normal carbonization processes with revivification *in situ*, whereas with a somewhat higher oxygen content severe corrosion may occur. The older coke oven plants, with their clayed doors, and entire absence of automatic control on the pull of the exhausters and dry mains, would tend to draw in air through the doors periodically, and especially when the carbonization was becoming complete. In these circumstances severe corrosion would be expected irrespective of the presence of H_2S. It can be shown beyond doubt that the most certain way of causing corrosion of steel holders is to overpull the retorts. The difficulty of explaining severe corrosion with 2% of O_2 and no corrosion with 1% leads me to ask whether it is definitely proved that oxygen is itself the cause of the corrosion, and whether it is not that the presence of oxygen is evidence of the presence of some other constituent, both arising from over-pulling. One can imagine that in the presence of iron in the coal ash and in the mains, overpulling the retort might lead to the production not only of SO_2 but also of SO_3. SO_2 should be absorbed in the condensing and scrubbing plant, but SO_3 is known to pass through almost any absorbent.

An important fact appears to emerge from this discussion. Unquestionably in the early days of gas making overpulling of the retorts was a recognized method of reducing the C.V. of the gas, and was not recognized as bad practice. Yet the early gasholders had often phenomenally long lives. One frequently comes across very old holders in which the sheets are perfect. The logical conclusion seems to be that apart from taking the now well-known precautions for making good gas—precautions equally essential on coke ovens as on gas-works—one should pay considerable attention to the materials of which the holder is constructed. The old holders were made of puddled iron, and they stood for generations. Surely it would be sound practice to revert to this material. There is no difficulty in obtaining genuine puddled iron sheets that are fully equal to those of a century ago.

I understand that there is a special corrosion problem in Australia and would ask the Author to give details of this. It appears to arise from the heat of the mid-day sun acting on one side of the holder which dries the water from the plates each day. The life of these holders is very short; I believe 20 years is considered good. Can this be due to salts, probably chlorides, in the tank water which are evaporated on the plate thus forming concentrated solutions, perhaps containing some ammonium chloride or magnesium chloride? Are these holders made of puddled iron or of steel? Does a similar trouble occur in all hot countries? The composition of the tank water cannot be disregarded when dealing with corrosion problems.

A Curious Problem

The pressure holder presents a curious problem. When the subject of the proper C.V. of gas to send out is under discussion, the gas engineer will generally object to going beyond a certain C.V. on the ground that the mains will not take the higher volume and that it is unthinkable to increase the pressure in the mains by a few inches. But he quite cheerfully envisages storing gas at 50 or 100 lb. pressure and conveying it from the works to the holder under those pressures. The pressure holder appears to me to have only one justification from a fuel technological point of view—and that is when a distant district served by a small holder is to be supplied through mains which are too small for peak loads. It may then prove useful to pump high-pressure gas into a pressure holder through the too-small mains during the night so that it can be released into the water-sealed holder as required to deal with peak loads. In other circumstances the cost of compression will add materially to the cost of conveying the gas; and it is the duty of gas engineers to obtain the cheapest gas per therm usefully employed at the consumers' appliances. Calculating from the well-known formula for adiabatic compression, and taking the cost of power at 0.75d. a unit, the cost of compression is as follows:

Abs. pressure at compressor outlet,	50,	100,	200 lb./sq.in.
Cost of compression in lb. per 1,000 cu.ft.,	1.6d.,	2.35d.,	3.2d.

Even for the lower ranges of pressure the cost is of the same order of magnitude as that of cost of gas into holder; and it seems therefore that we must have very good reason for doubling the cost of gas during distribution while striving to knock 0.1d. per 1,000 cu.ft. off the cost of manufacture. For this reason, among others, I am not, in the light of present knowledge, very hopeful of the method of making gas under pressure to which reference was made by Dr. Anderson.

Solihull Share Sale

Successful Issue

By direction of the Solihull Gas Company and with the consent of the Treasury, Messrs. Ludlow, Briscoe, & Hughes offered for sale by auction at the Grand Hotel, Birmingham, last week, consolidated shares of £1 each in the Solihull Gas Company.

The issued capital now consists of £152,653 in £1 consolidated shares entitled to a basic rate of dividend of 5% per annum, and £8,150 in preference shares. The Company is authorized to borrow an amount not exceeding 60% of the paid-up capital for the time being, including premiums. Debenture stock to the extent of £83,250, bearing interest as to £68,250 at the rate of 4% per annum, and as to £15,000 at 5% per annum, has been issued. Offers were then invited at the auction for 9,500 or sech less number of consolidated shares of £1 each, entitled to a basic rate of dividend of 5% per annum, as with the premiums would provide a sum amounting to not more than £9,000.

The shares were offered in lots of 100 each. Eighty-six lots were sold at prices ranging from £104 15s. to £105 15s. each.

A.R.P. Specifications

Copies of the following recently published British Standard Specifications (A.R.P. Series) can be obtained on application to the Secretary, The Institution of Gas Engineers, 1, Grosvenor Place, London, S.W.1.

BS/ARP/15.—Light-locks at entrances to buildings. (February, 1940.) (Superseding BS/ARP/15, September, 1939.) Price, 8d. each.

BS/ARP/27.—Testing incombustible material resistant to incendiary bombs. (February, 1940.) Price, 3d. each.

BS/ARP/39.—Testing fire retardent timber treatment by exposure to the action of an incendiary bomb. (February, 1940.) Price, 3d. each.

Brush Electrical Co.'s Development

Due to the expansion of the Brush Electrical Engineering Company's Sales Organization in the Manchester area, they have opened new offices at Daimler House, Wilmslow Road, Rusholme, Manchester, 14. (Tel.: Rusholme 2205/7.)

YORKSHIRE JUNIOR GAS ASSOCIATION

Presidential Address

Delivered at a Meeting of the Association held at Leeds University on Jan. 27

of

T. G. LEWIS,

Leeds Gas Department

In this Address I do not propose to describe any part of the plant used in gas manufacture and distribution. Interesting as they are, I feel that it is better to leave them for meetings where discussion is permitted so that the maximum benefit is obtained. Instead, I am going to try to interest you by giving a resumé of the Industry during my association with it, together with a few ideas that occur to me for the future.

It is a little over 21 years since I first entered the Gas Industry, and from the very start I must admit that I have found it most absorbing and interesting. To-day, the Industry is more interesting than ever, though we are faced with new problems due to the war and changing conditions.

Two Competitive Fuels

There are two important points that cause grave concern. The first is the fact that practically all the Industry is at the moment producing two fuels for heating purposes—namely, gas and coke, which for many purposes are in competition with one another. This is a fact that I cannot stress too strongly, for it is one which may yet change the gas-making policy of the Industry. Happy is the undertaking that is able to sell its gas and have no surplus coke.

Secondly, the ever-increasing competition from the electrical industry should make all Juniors rally to the fray. The man on the works, the distribution engineer, the salesman, and the appliance manufacturer all have an important part to play. There is sufficient material in these items to occupy the mind of any Junior in the Gas Industry.

Looking back over the past twenty-one years, I have seen many advances made within the Industry where progress has been most marked. In 1929 came the passing of the Gas Regulation Act which marked the start of the revision of legislation for the post-war reconstruction of the Gas Industry. Under the provisions of this Act the therm basis of charge was introduced. Subsequently, provisions of this Act were extended and amended by the Gas Undertakings Acts of 1929, 1932, and 1934.

From a works comparison point of view the therm was a much wanted improvement. It is regrettable that to-day we still see quoted figures of make per ton of coal carbonized, and comparisons on this basis. Would it not be far better to cast this fetish away and always refer to therms per ton? It is essential that a common standard should be established. That to-day is undoubtedly the therm. When quoting carbonization results, not only gaseous therms should be calculated, but therms of coke, benzole, and tar. I venture to suggest that if this system was common practice some of the thermal carbonization balances would take on a different aspect, and comparisons would become of greater value.

Education and Research

In 1929 the Institution was granted a Royal Charter, and the Institution Education Scheme had taken a more definite form. This scheme to-day is much valued by Juniors, for a young man entering the Industry appreciates the fact that after attending a series of classes, and passing the examination for these, he is entitled to sit for the examinations set by The Institution of Gas Engineers. The passing of these gives him the necessary qualifications to become a member of the Institution. This is having a beneficial effect upon the personnel of the Industry.

One of the greatest steps made by the Industry has been the appointment of Gas Research Boards by the Institution, whereby matters of vital interest are examined and research is carried out by eminent scientists, whose findings are published and discussed, so that the knowledge obtained is available for all. After reading some of the Reports of the Gas Research Boards, I sometimes wonder if we Juniors make the maximum use of them. I venture to suggest that a meeting devoted to the discussion of one or more of the Reports would be time well spent, and might result in the more ready adoption of their findings.

In fact, we might go further and arrange Joint Meetings with other Junior organizations—in our case the Manchester Association—at which one of the Research Fellows might give his Report and permit members to discuss it. I feel sure this opportunity of meeting with the men who carry out this valuable work would be appreciated by all Juniors and would ultimately prove of value to the Industry.

We have further evidence of co-operative endeavour in the work carried out by the British Commercial Gas Association whose publicity is very intensive. The work done by this association and its subsidiary organizations is most commendable, and we owe a great debt to its untiring efforts to place gas as the National fuel in the forefront. I am of the opinion that a direct result of the splendid work of the B.C.G.A. is the increased sales of gas in many districts.

On the Works

Carbonization.—In works processes and plant design the general tendency has been to reduce operating costs, the simplification of existing plant and in many instances to reduce the site area occupied by the plant.

There is little doubt that the greatest progress has been made in carbonizing practice. The evolution of the vertical retort system, including the intermittent type, vertical chamber oven, and the continuous vertical retort system has brought about a marked change. In these systems we have two plants in one, a coal carbonization unit, which incorporates the equivalent of a water gas unit. One should be cautious in considering the production of water gas by this method, since, compared with standard methods, it has a low efficiency. In the absence of alternative methods, the combined plant gives a ready means of making a gas of any declared calorific value.

This method of carbonization is still gaining favour, and progress is being made in two directions. First, improvement is being made in the size of the retort and the method of heating, and it may be that the larger intermittent retort which is being built may prove the next step in the line of progress. Secondly, the greatest development has been made in the method of constructing the settings and the materials used for this work. To-day silica segmental retorts are being used that will give a working life of over 1,500 days carbonizing at maximum throughput per day. I am emphasizing the maximum throughput statement since I am of the opinion that a vertical retort will work for an indefinite period provided the throughput is reduced and the carbonizing temperature controlled accordingly. It is not the temperature to which the retort is submitted that determines the working life, but the quality of the retort material to withstand the attrition due to the coke passing down the retort. As a retort ages the throughput of coal is automatically reduced, due probably to the condition of the retort surface. When this falls below a predetermined figure the time for a rebuild or thorough overhaul is at hand.

On the works on which I am employed 8,000 tons of coal carbonized per retort is approximately the life of the existing

50-in. retorts. These have carbonized a maximum quantity each day. It is interesting to note that these retorts were not built entirely of silica material; had they been, their useful life would, in my opinion, have been longer. It should be remembered that the greater the throughput of coal per day, provided carbonization is complete, the largest number of therms per retort are obtained, which consequently gives the lowest working cost. Attention to this in carbonizing practice is all important, as the basic cost of gas manufacture is effected; or, in other words, the more coal carbonized in a given time, the cheaper the therm, because both capital and labour costs are involved. This is most important where benzole extraction is practised.

Purification.—Except for improvement in the conditioning of oxide, and further knowledge gained in the chemical reactions taking place which have helped to formulate more exacting conditions for purification, such as temperature control, ammonia and moisture content, purification has shown few changes. Changes made have been in the general construction, the tower purifier representing probably the most forward development.

Although extensive experimental work has been done in the total removal of sulphur compounds, this has not yet reached the stage of being a works proposition.

What a blessing sulphur-free gas would be, not only to appliance manufacturers, but to the people who really matter, the gas consumers. Think of the benefits the Industry would gain—a greater use of flueless appliances and a great reduction in water heater maintenance provide two examples alone. General opinion seems to be that slight reduction in sulphur is of little use, but that it must be completely removed. The time is at hand when we should be in a position to give consumers sulphur-free gas. We cannot afford to lose their goodwill.

Condensation.—In this important and yet simple operation of gas-works routine, the controlled water type of condenser is now the most popular, the aim being to give maximum efficiency and to use the outlet warm water in the works boilers. Provided the quantity of water used on the works exceeds the quantity used in normal working on the condensers some efficiency can be sacrificed in favour of a more simply designed condenser. This is a technical detail that must not be overlooked in considering the constructional details of a condenser of the water-tube type.

Liquid Purification for Ammonia Removal.—This is still one of the simplest operations on the works and one which has shown little change. The modern tendency to displace rotary type washers with the static type is noted, particularly for benzole recovery and naphthalene removal plants.

Holders.—The storage of gas is to-day of importance. Of late years the waterless holder has gained favour among engineers, but by the public it is still viewed as a blot upon the landscape. In view of the fact that our Association was favoured with a remarkably good Paper during the past session on "Choice of Gas Storage" by Mr. W. S. Hubbard, I do not wish to dwell further upon the subject, but would only add that in my opinion future gas storage may well develop on the high-pressure principle.

Distribution

One branch of the Industry which has made progress but yet is a most expensive item in the analysis of gas costs is distribution. It is interesting to note that in a recent statement by one of the largest undertakings in the country the total cost per therm of their gas was 8·471d., and of this, distribution accounted for 4·162d. To me, employed in the manufacturing side, this seems a large proportion of the total.

The most marked advance in distribution might be said to be the use of high-pressure mains, steel mains, and spun pipes, together with patented pipe joints giving greater flexibility in order to minimize the risk of fracture under modern road strains. The removal of naphthalene at the works has helped materially to reduce naphthalene troubles.

The post-war years have seen the application of science to the Industry, there is not one branch where the hand of science cannot be felt. The large number of scientific instruments, the accuracy and reliability of them bears testimony to the work of the scientist and the scientific instrument maker. To-day these instruments are an integral part of the works equipment. It is interesting to carry one's mind back twenty years and to think of the instruments that we used to have and to compare them with their modern equivalent.

Progress in Works Practice

I joined the Industry when the late war had just come to an end. During the 4½ years of conflict our Industry had done a very great National Service. Supplies of gas had been maintained, in many cases with old plant, benzole washing, although it was standard practice in the coke oven industry, had been introduced, and many works also installed rectification plants for the recovery of pure benzole and toluene.

At this time it is interesting to note that the practice of steaming the charge of coke in the retort was not common, and the rectified spirits produced contained a very small percentage of paraffin hydrocarbons. An average figure would be 3% to 4%, according to the type of coal carbonized. To-day, with steaming as the practice in all vertical retort installations and in some horizontal retorts, the quantity of paraffin hydrocarbons is present in large quantities and may be so high as seriously to interfere with the production of T.N.T. from the rectified product.

In Leeds we pride ourselves on being one of the few undertakings that have continued to extract benzole from the gas and to rectify it from 1919 to the present day. In 1934 a plant for the making of crude benzole was completed at the Meadow Lane Works for the washing of the vertical gas. To-day that plant is regularly recovering 2.45 gallons of 90% crude benzole per ton of coal. This reduces the gas approximately 22 B.Th.U. per cu.ft.

The Future of Coke Production

It may be that in the future coke production will be a deciding factor in the method of carbonization. The popularity of the continuous vertical retort has seen a change in the type of coke produced, which has characteristics very desirable for the open fire, where easy ignition and combustibility are important factors.

Unfortunately these very factors are not in its favour for industrial purposes. As a domestic fuel, vertical coke is very adaptable and will give good results when burnt in the ordinary grate and excellent results when used in a specially designed grate. Unfortunately in some districts the domestic coke market is very small. In spite of the work of smoke abatement societies the coal fire is still the more popular, particularly where consumers live near a coal field.

I look forward to the day when the experimental work of Dr. Dent and his fellow corroborators on the hydrogenation of coal becomes a works proposition. When that day comes we shall have gone a long way towards reaching perfection in gas manufacture and in the utilization of the nation's coal reserves. Until then we should concentrate on producing the least possible quantity of saleable coke and do everything possible to promote coke sales. I believe that there is one Yorkshire undertaking which allows a certain amount of coke at a cheaper rate to each gas consumer in ratio to his gas consumption. In this way we could help to foster a gas consumer and make a coke consumer.

If in Leeds 10,000 householders would burn 1 cwt. of coke per week, either in an open grate or in a domestic coke boiler, the amount of coke thus sold would go a long way to solving the excess coke problem with which we are faced. If every house that has been built by the municipality and private builder—note that Leeds intended to demolish 30,000 houses—had installed a domestic coke boiler in place of the fireback boiler, we should be faced not with the problem of coke in excess, but coke shortage. The work of the London and Counties Coke Association is to be commended. In one year 150,000 of these boilers were fitted in their area.

The cost of installation need not be high, provided the necessary provision is made when the house is built. This system of burning coke has an added advantage inasmuch as the fire is enclosed and the danger of flying bats is reduced to a minimum.

I installed in my house a domestic coke boiler three years ago, and since its installation it has given no trouble but every satisfaction. The coke used is screened breeze, and this burns well for a period of 12 hours without attention. The fire is maintained 24 hours per day and only allowed to burn out when the accumulation of bats in the fire bottom warrants it. We always have a good supply of hot water. The room housing

the boiler is maintained at a comfortable working temperature which is a detail that is appreciated. Coke consumption is approximately 1¼ cwt. per week. The boiler is made of welded steel and is bower-barffed to prevent rusting. I know of no reason why the boiler should not be made of copper. After three years of working I am convinced that there is a definite future for the domestic coke boiler if its merits are made known.

To promote the sales of coke I think that gas salesmen in small undertakings should also interest themselves in coke, and should be trained in coke utilization. In this way they would be in a position to advise customers as to the size and type of coke required for their particular purpose. In some undertakings Coke Sales Superintendents have been appointed and no doubt have proved an asset in educating the public in coke and its utilization. Purchasers of coke might be persuaded to state the exact purpose for which the coke is required. By this means greater satisfaction would result. A customer who has received satisfaction will continue to a be coke buyer and a recommendation to others.

The alternative to the development of domestic coke sales is to do all that is possible to make less coke. The first thought, then, is total gasification; but as yet this system is only in the experimental stages and owing to the high pressures at which these plants are worked it may not yet be practicable on the gas-works of to-day. So the Industry must become more coke minded, more enthusiastic as to the development of domestic coke sales; these are always with us, whereas the industrial user may be a fluctuating consumer.

The Industry and the War

We, like all other business concerns, very quickly felt the effect of the war, some districts more than others. The first effect was the large reduction in gas sales due to the blackout. If this has done nothing else it should make us appreciate the street lighting load. Further reductions have been caused by the evacuation of families, though to some districts this should prove an advantage. Fuel rationing and appeals for general economy have all helped to reduce our gas sales, and with them the demand for new appliances.

In the month of September last year the drop in gas sales in the London area was 25% and the loss in revenue £2,500,000 per annum after allowing for reduction in coal carbonized. This amounts to a net loss of £1,800,000 for one company. The immediate result has been that that company has had to increase its gas charges approximately 25%. It will be readily agreed that this is a serious state of affairs. I cannot think of anything that is more likely to restrict further gas consumption than to increase the price. Although the public may be prepared to pay more for the gas they consume there is a limit to which they will go without making every endeavour to cut down consumption to a lower level in order to balance their account.

The second marked effect we have had is the rapidly rising costs—increase in price of coal, now partly offset by the increased price obtained for coke, increase in transport costs, labour charges; in fact, everything that we use shows an increase.

Owing to the increased cost of gas oil and the market value of coke, the manufacture of water gas is too costly except for use during an occasional peak load. This is to be regretted, because the water gas plant is a ready customer for surplus coke.

Our Industry, ranking as an important branch of public utility, has been faced with large expense in the form of civil defence. Although this may have been met in part by Government grants we have still had considerable charges to meet. The ingenuity of managers has been tested in the provision of shelters for workmen and protection for works plant against bomb and blast. The provision of inter-connecting mains, by-pass valves, &c., for use in emergency, the maintenance of standing gangs of A.R.P. personnel and equipment have proved a heavy expense.

The curtailment of building, particularly housing estates, on the suburbs of towns and cities will have a marked effect. The Gas Industry has been to no little expense in developing these areas, laying mains, installing boosting or compressing plant to supply outlying areas, with the hope that they would continue to develop into profitable areas and repay the money expended in giving them an adequate supply of gas. It may now be that for some time these districts may not consume sufficient gas to give a fair return on the cost of supplying the gas to them. When the war is over much canvassing and hard work will have to be done to make up for the time lost.

After the War

I have no doubt that the general result of the war will definitely be to reduce our gas sales, and so it is our duty now to prepare for peace.

One thing I believe we should be able to do is to offer consumers, particularly new consumers—and there should be a lot of young people starting a home—appliances that are attractive and efficient at a price they can comfortably afford.

There should be a demand for a cooker of a standard type costing, say, £6 to £7 that is attractive in design and finish which will appeal to the modern housewife. Young people like a modern article, but from my experience they cannot afford to pay £12 to £16 for a cooker, and, speaking as a layman, I cannot see value for money in a cooker so priced. I have sometimes made a comparison between a small motor car—priced at, say, £140—and a gas cooker priced at £14, and have endeavoured to decide the relative value. I must admit, I can see more value in the motor car.

The same applies to gas fires. If we are to interest the new consumers—I emphasize the new consumers—we must be able to offer them good appliances at a reasonable price, so that when fashion changes they can afford to change them. This must be coupled with gas at a price they can afford; then the deleterious result of the war will soon be overcome.

With regard to the price of fires, there is one significant fact that causes alarm—namely, that practically any universal store or large shop is prepared to sell to the public an electric radiator priced as low as 8s. 6d. complete with an adapter. I agree that for more elaborate fittings higher charges are made; but the fact is that it is possible to provide an efficient heating unit for so low a figure, and one which anyone can install. As long as this persists we shall have to make a bigger fight than ever to maintain the gas fire load. The manufacture of a cheaper appliance of more standard type would help to meet competition.

In the industrial field we are making progress in the efficiency of appliances, and the number of installations are growing. The application of gas heating to industrial processes may boom owing to the increased industrial activity caused by the war, and particularly in the armaments, machine, and tool making industries. This to some extent will help to neutralize the loss of domestic consumption. To many this will be considered good business and to smoke abatement enthusiasts a step in the right direction, but in one field I think we must be careful, and that is where we are installing gas-fired plant to the detriment of coke—for example, in central heating installations. Remember that the more gas sold the more (under present carbonizing conditions) coke produced, in a market already overstocked, and coke stocking allows the coke to deteriorate and is an expensive operation. Another important factor is that the price charged for industrial gas is much lower according to the amount consumed, which brings the ratio of revenue for gas sold to coke produced much wider apart than is the case with a domestic consumer. To all gas undertakings it must be remembered that the domestic consumer is the life blood of the Industry and must be encouraged and catered for by every means in our power; nothing will encourage him more than cheap gas.

It may be that with Government support the coke oven industry may compel us to purchase coke oven gas. Just as we have Central Electricity Boards we may have Joint Gas Boards controlled by Government officials. If this should materialize it is essential that the personnel of any Gas Board should consist of men who have been trained in all branches of the Gas Industry, and not Civil Servants with little knowledge of our Industry.

The future of our Industry depends upon the Juniors, and it is our duty to carry on the work that has been done during the last twenty years. In this period a firm foundation has been laid on which to build a strong progressive policy. Big decisions will have to be made; let us prepare ourselves and be ready to make them.

While not trying to detract attention from our main business of selling gas, I would appeal for an endeavour to sell

all the coke we can locally. The opportunity is here, during the war period when national appeals are being made for reduced coal consumption to allow more coal for export, and more by-products to be recovered. We should take this opportunity to convince the public that we can not only supply them with good gas, but also with something better than coal.

Vote of Thanks

Mr. J. W. Wood, B.Sc. (Leeds), proposing a vote of thanks to the President, congratulated Mr. Lewis on an Address which might be regarded as a very helpful stock-taking of the Gas Industry in general. It was, he felt, particularly useful in that it gave those of them who were specialists in one department or another a general review of the Industry, which it was as well they should have occasionally, lest their own outlook became narrowed by their limited sphere of work. Mr. Lewis had rightly emphasized that the Gas Industry must progress as a whole, and he had shown in which directions things might be regarded as very satisfactory and others in which they might be improved.

Mr. J. A. Derbyshire (Gainsborough), seconding, said the President had mentioned reduced output owing to war conditions, and in his (Mr. Derbyshire's) opinion one of the causes of reduced output had been the psychological effect of the fuel rationing fear. Having in mind the possibilities of an excess of coke after the war, Mr. Derbyshire felt the trend of events in the Gas Industry was likely to be towards more complete gasification of coal.

The President, responding, said his own feeling was that the future of the Industry was likely to be bound up in questions of coke as much as questions of gas.

"Sales"

By

R. COWIE, Jnr.,

of Hawick

This Paper was presented recently at a meeting of the Scottish Junior Gas Association (Eastern District).

As an Association we concern ourselves mainly with the Engineering side of our profession. The Salesmen's Circles, of which there are now two in Scotland, cater adequately for papers and discussion on sales topics. However, there is nae law agin reading papers of this kind at our meetings. Indeed, the reception accorded to such as have been read in the past encourages me to bring a few further thoughts on the subject for your consideration. It may serve as a curtain raiser to the address we hope to have from Mr. W. D. Rowe, Manager of the British Commercial Gas Association, at our next meeting.

The birth of a vigorous sales policy in a town I know well evoked the following remark from an otherwise intelligent and seemingly successful business man, "But why advertise gas—haven't the public got to use it and they won't use any more than they need." That man has changed his mind since then—but, as Kipling would say, that is another story.

As an Industry our function is to provide certain services to the public as the lowest possible cost compatible with quality of service and a fair profit to the Industry. To acquire these services the public must purchase appliances and the necessary gas to enable the appliances to provide the service. Every member of the public must be aware of the existence of the commodity—gas, but few if any have a full knowledge of the extent and scope of the services available and still fewer feel the need of these services in their own case.

The first function of a sales department must, therefore, be to make the public aware—to educate them in a knowledge of what service gas can render to them. Before they can even begin to learn, however, they must be interested—so the sales department must catch their attention and interest. When interest has been aroused and knowledge acquired the value of the service begins to be appreciated and sought after. The next step is obviously to make it as easy as possible for the service to be acquired and then to see to it that the service is so good as to be even better than the individual had thought it to be. The B.C.G.A. advertisements used to carry a small panel containing the words, "It is our aim to give a good service to-day, a better service to-morrow, and ultimately the best service it is possible to render." The advertisements for which I am responsible have carried these words with almost monotonous regularity. I like them, they show the right spirit, and we try to live up to them.

Gaining Goodwill

If, then, we render a satisfactory service, we may expect to gain the goodwill of our consumers. Goodwill very quickly brings more business and a state of mind has been created among the public in which they naturally think of gas when they require any of the services which our Industry is so capable of giving. We can then declare that our sales department is functioning as it should.

But we are not alone in the world of business and many other worthy individuals and firms are providing valuable services and commodities and are equally anxious to dispose of them to the public. Indeed, so many are struggling for recognition that the public must choose between one and the other. The public does not necessarily choose the most worthy; it chooses the one which it believes to be so—not quite the same thing. Indirect competitors, motor cars, furniture, wireless, and the rest are just as likely to crush us out of the family shopping list as are our direct competitors in the fuel market. These, then, are the reasons for a vigorous sales policy whose function, as I have shown, is to create interest, provide information and education, give good service and thus create for our industry the goodwill of the public.

The methods adopted to achieve this desirable end are very closely interconnected and can only be dealt with separately to a limited extent. They fall under two main headings—Propaganda and Service. I shall comment upon them in that order. Thoughts and ideas can be communicated by either speech, writing or display. Every word that is spoken by the members of our Industry adds its quota or influence on public opinion for good or ill. This places a responsibility on every one of us, but most of all on those members of the sales and distribution staff who come in contact with the public in the course of their day's work.

Obviously these folks should be of good address and with enough gumption to say the right thing at the right time. They are much more likely to do so if they think well of the undertaking they work for, are convinced of the value of the service, are of a sympathetic and obliging nature, happy in their job and secure in their knowledge of gas and its application to the needs of the public. Inspiring and cheerful leadership combined with periodic lectures and discussions are invaluable in cultivating these qualities.

Speech is the main faculty by which we make contact with our fellows. It is impossible to over-estimate the importance of correct speaking.

The Salesmen's Circle had a very successful speech training class in Edinburgh two winters ago, but I regret to say that the class was not supported by salesmen as it should have been. It was discontinued. I sincerely hope that it will be revived after the war. To speak well "with proper emphasis and discretion, with good taste and even a certain amount of melody and grace of style requires study, discipline, care and the cultivation of the ear and vocal organs for a ready appreciation and execution of tone."

Tools of Salesman's Craft

Words are no less important than the way they are uttered. As Columbus Jr. puts it in a recent "Gas Salesman," they "are the tools of a salesman's craft. A salesman's vocabulary is, therefore, very important. He must study words constantly and learn how to use them and be able to apply the right words incisively at the right moment." The so-called gift-of-the-gab is discounted and rightly so; no less is what is known as high-pressure sales talk. You know what I mean—the salesman works on the principle that if he says "yes" often enough the customer will forget how to say "no." In business as in private life good reputations are hard to come by and easy to lose. A few misguided words will in as many seconds demolish goodwill which it has taken years to build up. Let us have forceful selling by all means, but selling based on a true appreciation of the needs of the consumer, a knowledge of the service and carried out with earnestness, dignity and good humour by salesmen with a knowledge of the English language and trained in its use.

The number of people with whom we can communicate by speech is obviously limited ,but by means of written advertisement we can reach thousands and repeat our message over and over again. It has been definitely shown that advertising can and does stimulate demand; but in my opinion the full value of Press advertising has yet to be realized by the individual gas under-

taking. I make no apology, therefore, for stating once again the fundamentals of Press advertising. You may never need to draw up an advertisement, but you may have to buy one from someone who does, and it is as well to know something about the subject.

Press advertising must be carefully planned and should be consistent—a small space taken regularly is better than a big one at intervals. Position is important—the right-hand top corner of a page is twice as valuable as the left-hand bottom corner. In books or magazines the right-hand pages are better than the left. The advertisement should be close to editorial matter and on a page with as few other advertisements as possible. If the advertisement can be placed beside appropriate editorial matter so much the better. The larger the space taken the greater the power of attraction, but attraction does not increase in direct ratio to the size, but rather as the square root of the space.

As for the advertisement itself, the headline should command attention, be not more than five words and be a message in itself, unless it be in the form of a question inviting further attention. The illustration must be vital and attractive—a still-life illustration is better than nothing, but not so good as one that lives. The copy should be written in a simple, forceful, and straightforward style, but there are few really good copy writers.

Appeal to Women

The appeal should be mainly to women. "The hand that rocks the cradle controls the purse strings in most homes." This appeal may be made in a number of ways—to the parental instinct or to the instinct of self-preservation, or the cult of health. Again it may be to the acquisitive instinct or to the sentiment for science, for science is fashionable in these days. Men and women are not only acquisitive but inquisitive, so it is sometimes wise to give them a peep behind the scenes and tell the story behind the service or appliance. But in appealing to the instinct let us not forget that our appeal will be strengthened enormously and a more favourable response rendered much more certain if we can ensure the co-operation of the intelligence as well as the instinctive tendencies.

I might mention here that in my opinion the best slogan ever coined by the B.C.G.A. was "Get Up-to-date with Gas." It was an appeal to the acquisitive instinct and at the same time emphasized the modernity of gas. If I might dare to criticize so worthy an institution as the B.C.G.A., I would say that they could save money and do more good for the Industry by not changing their appeal and style of advertisement so often, but rather keep hammering away at the best ones.

It is, of course, essential that the copy be written from the readers' point of view and that is not easy. Where possible the advertisement should be topical.

The layout is very important. It is fatal to crowd the space with matter. Contrast attracts attention and contrast can be achieved by the use of white space or by contrasting type. The border should not be too heavy—nowadays borders are being dispensed with altogether. Of course, the name of the undertaking, with telephone number, must be clearly set out; even if nothing else is read some good will be accomplished.

"Editorial publicity" cannot be bought and is all the more valuable for that. Gas men have complained bitterly about the fact that our competitors get more of this publicity than they do. All the more reason why we should do something about it. We must try to appreciate what is news and what is not; if it is news and we get it along to our local paper promptly—typed out and ready if possible—then we'll get it printed. Photographs are even better publicity than editorial matter. May I illustrate an example from my own experience. A water heater in a kitchen is commonplace, but a water heater in the middle of a garden is news. A hint to the local newspaper photographer was sufficient to bring him to the garden party, and the photograph duly appeared in the next week's *Hawick Express*.

I wonder if we write letters to our consumers as often as we should—a well worded and neatly typed letter can go a long way towards creating a good impression. It might be going too far to suggest that we write just for the sake of writing, but we should take every opportunity or every excuse to bring ourselves to the notice of the public. What about the salesman in the showroom jotting down one or two letters to prospects or to recent purchasers when things are quiet and the typist filling in her odd moments by typing them? Stereotyped letters are used regularly by most progressive sales departments, but I have a feeling that something more personal would yield results out of proportion to the extra work involved.

Poster Publicity

Posters are really a form of display, they are for the most part observed by people when they are thinking about nothing in particular—when they are walking along the street, for example. They are essential to a complete publicity campaign. Excellent posters are available from the B.C.G.A. at a very modest figure and from appliance manufacturers free, gratis and for nothing. There has been a lot of grumbling about gas posters not getting good sites. As far as existing hoardings are concerned this is true, but not to be wondered at. We are newcomers in this field of advertising and we are not entitled to the same consideration as are firms who have patronized the hoardings for half-a-century or more. This difficulty can be overcome by securing new sites if available, or, if not, by fixing a long-term posting contract, subject to certain specified sites being included. In our own case there is only one hoarding on the main thoroughfare—after three years we have got a place here and we mean to keep it.

Actual Demonstration

It is worth while to get gas appliances fixed in public places. No matter how good descriptive matter may be it cannot be as good as letting the public see the actual appliance. Doctors' waiting-rooms are often mentioned in this regard, but they are by no means the only places for publicity of this kind. The garden party already referred to is a case in point and this was the third occasion when we had fixed up an "Ascot" boiling appliance at a convenient point in a garden for a Women's Guild responsible for the catering. On each occasion we could trace sales which were a direct result of the effort. The public don't know how good gas is—if they did our outputs would be doubled. Let us see to it then that clubs, institutions, halls, church premises, and pubs are all well equipped with gas appliances. We recently fixed a couple of coke fires in a local hotel, since when no fewer than twelve different persons have asked for fires "like the ones in that hotel." A hotel, mark you, where the most of the patrons come from outside the district. Doubtless this installation has helped the sale of coke fires further afield.

It is at the showroom itself that display is most valuable, however, for there the actual appliances are seen at the point of purchase. If goods cannot be sold to prospective customers who see them, other forms of advertising are of little avail. The sight of the appliances in the showroom is the psychological blow that clinches the efforts of the advertising system. Great pains must, therefore, be taken to make the appliances as attractive as possible. The showroom must not be crowded, and every effort made to concentrate attention on *individual* appliances. As far as possible the appliances should be live. Judicious use of display material, utensils, and artificial goods are obvious aids and suggest all sorts of attractive possibilities in the consumer's own home.

Service

I have dealt at some length with propaganda; what I have to say about service will have to be put in tabloid form.

(1) The consumer must be considered first, last, and all the time.
(2) Promotional tariffs get business and are more equitable than a flat rate of charges for gas.
(3) Hire purchase and P.T.M. are part of our service and capable of development.
(4) Escapes and stoppages are always dealt with promptly—jobs required in a hurry to suit the consumer's convenience should be similarly dealt with.
(5) We should be prepared to put appliances out on approval. The salesman should be allowed to exercise his discretion and initiative in making concessions.
(6) The showroom may sell appliances but it is maintenance that keeps them sold.

A paper on sales at this time would be incomplete without some reference to the war. However much we may deplore it, we have got to put up with it and do our share as far as we can to see the business through. We can best do that by carrying on as usual—as far as is possible. The services of Mr. Therm are more than ever required these days, to give comfort and convenience in the home. Here is our opportunity to increase the gas consumption of some of our less remunerative consumers.

Some gas undertakings seem to have made drastic alterations on their selling policy. Hire purchase and other conveniences have been thrown overboard. The policy of these undertakings may be justified, but it looks like panic to some people. Goodwill which it has taken years to build has been torpedoed overnight. Newspapers have published statements which show our Industry in a very poor light. One report headed "Cooker Bar to Altar" goes on, "Marriage dreams of many young couples have been disturbed by a cash-on-the-nail decree of the local gas company in respect of their cookers," "Unable to pay £9 spot cash for cookers to complete their home," &c. This doesn't read like a reference to an Industry which sponsors cookery classes for brides, or which has decided to make up the pay of employees serving with the colours.

The undertaking which I serve is fortunate in that it supplies a non-vulnerable area which received a large number of evacuees. We had very little street lighting to lose, so that the war has put our consumption up by about 6½%. New business in the domestic field was non-existent for the first fortnight of the war, but since then the sale of appliances has been normal for this time of year and shows a slight increase due to A.R.P. and other war work. Gas fires have been in demand for temporary offices.

Gas Undertakings' Results

Alnwick

A dividend on the consolidated stock of 4½% for the past year is being paid by the Alnwick Gas Company. There has been a decrease of 1% in the output of gas, the price of which has been increased by 0.6d. per therm.

Altrincham

The accounts of the Altrincham Gas Company for the past year show a revenue balance carried to Profit and Loss Account of £13,654, which compares with £10,028 for 1938. The quantity of gas sold is down from 535,989,800 cu.ft. to 495,673,100 cu.ft. After making a transfer of £2,000 from the Reserve Fund Account, the balance shown by the Profit and Loss Account as available for dividend is £4,678. This will provide for the full statutory dividend, and leave a balance of £1,004 to be carried forward. A year ago there was a similar transfer from the Reserve Fund, and there remained a balance to carry forward of £1,180.

Chester

The quantity of gas sold during 1939 by the Chester United Gas Company was 521,039,630 cu.ft., which compares with a total of 488,394,110 cu.ft. in 1938. Public lighting is nearly 3,000,000 cu.ft. down, but in spite of this gas sales show an increase of almost 7%. The balance of revenue carried to Profit and Loss Account is £16,458, as against £17.073 a year ago. The dividend on the ordinary stock for the year is 5¼%, which leaves a balance to carry forward of £6,242. The same dividend was paid for the preceding year, when the carry forward was £7,590. The work of enlarging the vertical retort plant has been completed during the year, and considerable main extensions have also been carried out. It became necessary in December to increase the ordinary price of gas from 8d. to 9d. per therm, with a corresponding increase on industrial and special contract supplies. The Directors inaugurated during the year a contributory pension scheme, membership of which is open to all co-partner employees, and the scheme met with a satisfactory and full response from all the staffs.

Cork

The report of the Directors of the Cork Gas Consumers' Company for the six months ended Dec. 31 states that, in comparison with the corresponding period of 1938, the accounts show a very satisfactory increase in the returns from sales of gas and residuals, though, on the other side, the cost of coals is a great deal higher. The balance on Profit and Loss Account is £3,277, and in order to pay the usual dividend at the rate of 8% per annum it will be necessary to draw £962 from the Reserve Fund. For the corresponding half of the previous year, after placing £2,170 to credit of the Depreciation Fund, the balance on Profit and Loss Account was £4,532. In the present accounts, while sales of gas and residuals are up some £4,000, the cost of coals is a full £10,000 higher.

Gloucester

Close upon 9% increase in the sale of gas during the past year is reported by the Directors of the Gloucester Gas Light Company, the total being 658,290,000 cu-ft. compared with 604,603,000 cu-ft. in 1938. On the present occasion the revenue balance carried to Profit and Loss Account is £19,215; a year ago it was £19,426. The total number of consumers at Dec. 31 last was 19,560, of whom nearly 8,000 were on the prepayment system. This total shows a gain of about 800 over the twelve months, 300 of them being prepayment. As in 1938, the price of gas during the year varied from 9d. to 1s. 0¾d. per therm, according to the areas of supply, less 5% discount for prompt payment, with special terms for large quantities. With the amount brought forward and a transfer from Reserve Fund of £306, and after the payment of a dividend for the year on the consolidated ordinary stock of 5¼%, there will remain a balance to be carried forward of £14,862—about £800 more than was brought in.

Harrogate

An increase of 6% in the sales of gas during 1939, as compared with those of the preceding year, was reported at the annual meeting of the Harrogate Gas Company. The actual figures are 2,824,055 therms for the past year. Rising costs have necessitated an increase in the price of gas of 1.35d. per therm. To enable consumers to adopt gas for all domestic purposes, including continuous room heating, a special "half-price gas" tariff was introduced early in the year. The immediate response showed that the advantages of the tariff were fully realized by

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the consumers, but unfortunately circumstances compelled its suspension during the latter part of the year. It has been possible now, however, to make it again available throughout the whole of the Company's large area. Central premises have been acquired, and modern showrooms and offices constructed at Wetherby. The maximum 6% dividend for the year on the new consolidated stock, and the co-partnership bonus for 1939 (£2,190), will leave a balance forward of £19,667. The co-partnership bonus to the employees represents an addition of 6% to their total wages and salaries for the year.

Kettering

The report presented at the annual meeting of the Kettering Gas Company stated that the business has been well maintained. Throughout the Company's district the work of development has proceeded steadily, with a corresponding all-round increase in sales of gas and appliances. The dividend for the year is 7%.

Shirebrook

The accounts for 1939 of the Shirebrook and District Gas Company show a profit for the year of £2,304. A dividend of 7% for the twelve months will leave to be carried forward to the next accounts the sum of £9,158. The amount brought forward from the previous year was £9,223. The Company purchase their gas in bulk.

Shotley Bridge and Consett

The Shotley Bridge and Consett District Gas Company are among those who were experiencing increases in sales of gas and appliances up to the outbreak of war, but who subsequently suffered as a result of the altered conditions. Thus sales of gas for the year totalled 90,625,000 cu.ft., which represents a decrease of 4.3% when compared with the sales during 1938. In view of the prospect of decreased revenue, and the certainty of increased expenditure, the Directors felt that they had no alternative but to increase the price of gas by 1d. per therm, or 5d. per 1,000 cu.ft., after the meter readings for the December quarter. A system of discount, based upon consumption, will be given in future to slot meter consumers. A new carburetted water gas plant has been installed to augment the existing carbonizing plant, which, had conditions been normal, would have been working to capacity. To meet the increasing demand locally for graded coke, the works have been equipped with a cutting and grading plant. A dividend for the year of 5% on the consolidated stock will leave the sum of £1,685 to be carried forward.

South Staffordshire Mond Gas

For the past twelve months the South Staffordshire Mond Gas Company are paying a dividend on the ordinary shares of 2%, as compared with 1½% a year ago. The gas distributed during the year was 6.7% more than in 1938. The quantity of fuel gasified during the year was 2.3% more, while the cost of this fuel was 1.7% more. The net profit on the past year's operations is £13,216, against £10,601 for the preceding twelve months. The Earl of Dudley has consented to join the Board.

Stamford

An increase in sales of gas during the past year is announced by the Stamford and St. Martin's Gas Light and Coke Company, while no increase has been made in the price. The profit on the year's working allowed of a final dividend of 7%, the sum of £3,916 being carried forward to the current year's accounts.

Swansea

The Swansea Gas Light Company experienced the big increase of 12% in sales of gas to all consumers during the past year, as compared with 1938. This excellent result is due to increased sales for industrial purposes; sales to domestic and commercial consumers actually showing a very slight reduction over the whole year. The quantity of gas sold in the past year was 2,439,529 therms, which is an increase of 267,318 therms over the total sales of 1938. Heavily increased, and increasing, expenditure, however, left the Directors with no alternative but to increase the price of gas by 1.2d. per therm as from the meter readings at the end of the December quarter. As it was not possible to decide upon an increase in price early enough to provide in the present accounts a compensating revenue for the rise in costs, the Directors have thought it prudent to reduce the ordinary dividend to 4% for the year.

Whitby

The accounts of the Whitby Gas Company show that the quantity of gas sold in the past year was 273,669 therms, which compares with 275,642 therms in 1938. The revenue balance carried to Profit and Loss Account on the present occasion is £3,575, against £4,471 a year ago. Dividends for the year of 6½% on the original shares and £4 11s.% on the additional and new additional shares will leave a balance to be carried forward of £785. In respect of 1938 similar dividends were paid, and the carry-forward was £1,317.

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Current Sales of Gas Products

The London Market

March 4.

Current values of tar products in the London market are as follows:

Pitch about 35s. per ton f.o.b.

Creosote about 5d. per gallon.

Refined tar 3½d. to 4d. per gallon.

The price of pure toluole under the Ministry of Supply Order is just under 2s. 5d. per gallon.

Pure benzole is about 1s. 10d.

95/160 solvent naphtha about 1s. 11d.

90/160 pyridine about 16s. to 17s.

All per gallon naked.

Refined naphthalene crystals about £20 per ton in bags.

All *ex* makers' works.

The Provinces

Feb. 26.

Crude Gas-Works Tar, 21s. to 26s.

To avoid misunderstanding, it is necessary to state that the above price is not claimed to represent a market value. It is a price worked out from week to week upon a system which has been used for many years as a basis for the fixing of certain contracts for crude tar of varying qualities in different areas.

The average prices of gas-works products during the week were: Pitch—East Coast, 35s. to 37s. 6d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 35s. to 37s. 6d.* Toluole, naked, North, 1s. 9½d. (Controlled by the Ministry of Supply Order No. 1, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 9d. to 9½d. Solvent naphtha, naked, North, 1s. 8d. to 1s. 9d. Heavy naphtha, North, 1s. 4½d. to 1s. 5½d. Creosote, *ex* works, in bulk, North, liquid and salty, 4½d. to 5d.; Scotland, 4½d. to 5d.; low gravity, 4½d. to 5d. Carbolic acid, 60's. 3s. 6d. to 3s. 7½d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil, (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls, whatever they may be.

Scotland

GLASGOW, March 2.

Trading throughout the week has been on modest lines but prices of most products are well maintained.

Crude gas-works tar.—Actual value is firm at about 34s. to 36s. per ton *ex* works in bulk.

Pitch.—Quite fair quantities have changed hands at 27s. 6d. to 30s. per ton f.o.b. for export and about 27s. 6d. per ton *ex* works in bulk for home trade.

Refined tar.—Home market continues quiet with quotations at 4¼d. to 4½d. per gallon. For export supplies are available at 2½d. to 2¾d. per gallon, both f.o.r. naked.

Creosote oil.—With supplies sufficient to meet demand prices are stationary as follows: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6¼d. per gallon; neutral oil, 5¼d. to 5¾d. per gallon; all *ex* works in bulk.

Cresylic acid.—Only small quantities are changing hands and makers' quotations are as under: Pale, 97/99%, 2s. 1d. to 2s. 3d. per gallon; dark, 97/99%, 1s. 10d. to 2s. per gallon; pale, 99/100%, 2s. 6d. to 2s. 9d. per gallon; all *ex* works in buyers' packages.

Crude naphtha is valued at about 7d. per gallon *ex* works in bulk, according to quality.

Solvent naphtha remains steady with 90/160 grade at 1s. 8d. to 1s. 9d. per gallon and 90/190 heavy naphtha at about 1s. 4d. to 1s. 5d. per gallon.

Motor benzole is 1s. 6½d. to 1s. 7d. per gallon.

Pyridine.—Prices are nominal with 90/160 grade at 15s. to 16s. per gallon and 90/140 grade at 17s. to 18s. per gallon.

Contract Advertised

Demolition of Gas Holders.

Kirkcaldy Gas Department. [p. 546.]

A.R.P.
PROTECTION OF SANDBAGS.

METRO CREOSOTE EMULSION

METRO COPPER CREOSOTE EMULSION

Both Emulsions conform to the Specification of the Ministry of Home Security Memorandum A.R.P. 279/1939 — 20/10/39, and are available in GREEN at slight additional cost.

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GAS STOCKS AND SHARES

Apart from the revival of activity in the Kaffir market, business on the Stock Exchange was on a reduced scale in most sections last week. The tone remained good, however, and prices generally continued firm. British Funds again moved upwards and 2½% Consols which were marked ex div. on March 1 closed at 74, the same level as a week ago. Home railway stocks were irregular, being adversely affected by profit taking and some disappointment over the L.N.E.R. dividend. Less attention was given to leading industrials, though on the whole prices were well maintained.

In contrast to some sections, the Gas Market had a better week. The volume of business was heavier, and it will be seen in the list below that a number of quotations moved upwards. Plymouth and Stonehouse showed the largest increase with a gain of 14 points to 116½. several parcels of this stock changing hands at 118½ against the last recorded transaction at 102 last month. Among other improvements, Southampton rose 4 points to 79½ and South Metropolitan 3 to 69½, while Mid Southern fixed-interest stocks made further gains. In the Supplementary List it will be noticed that the nominal quotations of two Cambridge stocks were very substantially marked up, the 10% stock by 35 points to 150 and the 7% stock by 15 points to 110.

Gas stocks and shares, which in common with all other securities began to depreciate some months prior to the outbreak of war, reached their lowest values towards the end of December. Since then many prices have been slowly recovering, and comparing the present quotations of some leading "ordinaries" with those on Dec. 22, it is seen that Alliance and Dublin has gained 5 points, British 10, Gas Light units 2s. 6d., Imperial Continental 12½, South Metropolitan 6, and Tottenham 5½ points. A number of fixed-interest stocks have made headway. Not all have been so fortunate. Commercial, South Suburban, and Wandsworth, have been marked down a few points lower.

Official Quotations on the London Stock Exchange

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Mch. 1	Rise or Fall on Week.
1,767,439	Sept. 4	8	8	Alliance & Dublin Ord. ...	120—130	...
374,000	Dec. 27	4	4	Do. 4 p.c. Deb. ...	80—90	...
877,576	Nov. 6	5	5	Assed. Gas & Water U'd'ts Ord.	14/6—16/6	...
500,000	"	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	17/—19/—	...
535,545	"	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/—	...
318,730	"	4	4	Do. 4 p.c.Irred. Cum. Pref.	13/6—15/6	...
750,000	Sept. 18	3½	3½	Do. 3½ p.c. Red. Deb. ...	83—88	...
560,070	Feb. 19	7	7	Barnet Ord. 7 p.c.	113—118	...
300,000	Oct. 9	1/9⅜	1/4⅜	Bombay, Ltd.	20/—21/—	...
181,185	Feb. 26	9½	9½	Bournemouth Sliding Scale ...	145—150*	−2
690,526	"	7	7	Do. 7 p.c. max. ...	118—123*	−2
493,960	"	6	6	Do. 6 p.c. Pref. ...	113—118	−2
50,000	Dec. 18	3	3	Do. 3 p.c. Deb. ...	68—73	...
362,025	"	4	4	Do. 4 p.c. Deb. ...	90—95	...
335,000	"	5	5	Do. 5 p.c. Deb. ...	105—110	...
357,900	Feb. 19	7½	6½	Brighton, &c., 6 p.c. Con. ...	103—108	...
459,955	"	6½	5⅞	Do. 5 p.c. Con. ...	100—105	...
205,500	"	6	6	Do. 6 p.c. 'B' Pref. ...	130—105	...
855,000	Sept. 18	8	7	British Ord.	100—110	...
100,000	Dec. 18	7	7	Do. 7 p.c. Pref.	120—125	...
350,000	"	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	111—116	...
120,000	"	4	4	Do. 4 p.c. Red. Deb.	73—78	...
450,000	"	5	5	Do. 5 p.c. Red. Deb. ..	98—103	...
100,000	22 May '33	6	4	Cape Town, Ltd.	¼—¾	...
100,000	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref.	¼—¾	...
150,000	Dec. 18	4½	4½	Do. 4½ p.c. Deb.	55—65	...
626,860	Jan. 29	6	5⅞	Cardiff Con. Ord.	100—105	...
237,860	Dec. 18	5	5	Do. 5 p.c. Red. Deb. ...	95—100	...
98,936	Oct. 9	2/—	2/—	Colombo Ord.	1¼—1½	...
24,510	"	1/4⅜	1/4⅜	Do. 7 p.c. Pref.	20/6—22/6	...
739,453	Sept. 27	−/11.48	−/11.48	Colonial Gas Assn. Ltd. Ord. ...	15/—17/—	...
296,144	"	1/3.30	1/3.30	Do. 8 p.c. Pref.	20/6—22/6	..
1,775,005	Jan. 29	4	2	Commercial Ord.	46—51	−3
140,000	Feb. 19	4	4	Do. 4 p.c. Red. Pref. ...	87—92	...
620,000	Dec. 11	3	3	Do. 3 p.c. Deb.	59—64	...
286,344	Feb. 19	5	5	Do. 5 p.c. Deb.	90—95	...
200,000	"	3¾	3¾	Do. 3¾ p.c. Red. Deb. ...	93—98	...
807,560	Feb. 12	7	7	Croydon sliding scale	98—103	...
644,590	"	5	5	Do. max. div.	82— 87	...
620,365	Dec. 27	5	5	Do. 5 p.c. Deb.	98—103	..
208 660	Feb. 19	5	5	Dudley, Brierley Hill & Dist. Ord.	98—103	−
82,275	"	5	5	Do. 5 p.c. Con. Pref. ...	93—98	+½
79,000	"	3¾	3¾	Do. 3¾ p.c. Red. Deb. ...	93—98	...
239,000	Jan. 29	5	88/6	East Hull Ord. 5 p.c. ...	80—90	...
187,215	Feb. 12	5¾	5¾	East Surrey Ord. 5 p.c. ...	93—98	...
176,211	Dec. 18	5	5	Do. 5 p.c. Deb. ...	90—100	...
250,000	Nov. 13	8	4	Gas Consolidation Ord. 'B' ...	14/—17/—	...
250,000	"	4	4	Do. 4 p.c. Red. Cum. Pref.	16/—18/—	...
12,152,410	Jan. 29	5⅜	3⅜	Gas Light & Coke Ord. ...	17/6—18/6a	+−/6
2,600,000	"	3½	3½	Do. 3½ p.c. max. ...	60—65	...
4,477,106	"	4	4	Do. 4 p.c. Con. Pref. ...	82—87	...
2,993,000	Jan. 2	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	85—90	+2
8,602,497	Nov. 27	3	3	Do. 3 p.c. Con. Deb. ...	75—80	...
3,642,770	"	5	5	Do. 5 p.c. Red. Deb. ...	105—110	...
3,500,000	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	100—105	...
700,000	Sept. 4	3½	3½	Do. 3½ p.c. Red. Ded. ...	87—92	...
270,466	Feb. 19	6	6	Harrogate New Cons.	93—98	...
157,500	Mar. 20	‡1/—	‡1/—	Hong Kong and China Ord. ...	⅛—¾	...
5,600,000	Oct. 23	12	4	Imperial Continental Cap. ...	80—85	+2
172,810	Jan. 29	3½	3½	Do. 3½ p.c. Red. Deb. ...	80—85	...
63,480	Dec. 18	3	3	Maidstone 3 p.c. Deb.	55—60	...
45,000		†10	†8	Malta & Mediterranean ...	92—102	...
				Metropolitan (of Melbourne) ...		
392,000	Oct. 2	5½	5½	5½ p.c. Red. Deb.	95—100	...
231,977	Feb. 19	5	5	M.S. Utility 'C' Cons.	75—80	...
368 ,658	"	4	4	Do. 4 p.c. Cons. Pref. ...	80—85	+4
390,076	Dec. 18	4	4	Do. 4 p.c. Deb. ...	82—87	+2

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Mch. 1.	Rise or Fall on Week.
148,955	Dec. 18	5	5	M.S. Utility 5 p.c. Deb. ...	102—107	+2
125,000	Jan. 2	3½	3½	Do. 3½ p.c. Red. Bds. ...	90—95	...
675,000	Nov. 6	†3	†4	Montevideo, Ltd.	55—60	...
250,000	Aug. 21	7½	7½	North Middlesex 6 p.c. Con. ...	105—115	...
396,160	Jan. 29	5	5	Northampton 5 p.c. max. ...	90—95	.
300,000	Nov. 6	†7	9	Oriental, Ltd.	118—123	−2½
468,537	Dec. 11	8	7	Plymouth & Stonehouse 5 p.c.	114—119	+14
621,667	Feb. 5	8½	8½	Portsmouth & Gosport Cons.	110—115	+2
241,446	"	5	5	Do. 5 p.c. max.	85—90	...
73,350	"	5	5	Do. 5 p.c. Pref.	87—92	...
75,000	"	4	4	Do. 4 p.c. Pref.	75—80	...
114,000	Feb. 5	5	5	Preston 5 p.c. Pref.	88—93	...
247,966	Dec. 18	4	4	Primitiva 4 p.c. Cons. Deb. ...	93—98	...
625,959	Jan. 15	4	4	Do. 4 p.c. Red. Deb. ...	91—96	...
15,000	Sept. 4	6	6	San Paulo 6 p.c. Cum. Pref. ...	7½—8½	...
441,275	Oct. 9	1/1½	1/1½	Severn Val. Gas Cor. Ld. Ord.	17/—19/—	+−/6
460,810	Oct. 2	−/10⅝	−/10⅝	" " 4½ p.c. Cum. Pref. ...	17/—19/—	...
133,201	Feb. 12	8½	5	Shrewsbury 5 p.c. Ord. ...	105—115	...
9,000	June 5	†4	†4	South African Ord.	4—5	...
1,996,297	Aug. 21	1/2⅜	1/2⅜	South East'n Gas Cn. Ld. Ord.	16/—18/—	+−/6
1,000,000	"	−/10⅝	−/10⅝	Do. 4½ p.c. Red. Cum. Pref.	17/—19/—	...
"	"	4	4	Do. 4 p.c. Cum. Pref. ...	14/6—16/6	...
769,191	"			Do. 3½ p.c. Red. Deb. ...	89—94	...
150,000	Feb. 12	3½	3½	South Met. Ord.	67—72	+3
6,709,895	"	5	4	Do. 6 p.c. Irred. Pref. ...	103—108	+3
1,135,812	"	6	6	Do. 4 p.c. Irred. Pref. ...	75—80	...
850,000	"	4	4	Do. 3 p.c. Deb.	67—72	...
1,895,445	Dec. 27	3	3	Do. 5 p.c. Red. Deb. ...	100—105	...
1,000,000	Jan. 15	5	5	Do. 3¾ p.c. Red. Deb. ...	92—97	...
600,000	"	3¾	3¾	South Suburban Ord. 5 p.c. ...	74—79	...
1,543,795	Feb. 5	6	3	Do. 5 p.c. Pref.	88—93	...
512,925	"	5	5	Do. 4 p.c. Pref.	78—83	...
500,000	"	4	4	Do. 3¾ p.c. Red. Pref. ...	86—91	...
250,000	"	3¾	3¾	Do. 5 p.c. Deb.	100—105	...
888,587	Dec. 11	5	5	Do. 4 p.c. Deb.	85—90	...
250,000	"	4	4	Do. 3½ p.c. Red. Deb. ...	84—89	...
200,000	Feb. 12	3½	3½	S. Western Gas & Water Ord.	13/6—15/6	...
427,859	Sept. 18	1/2⅜	9⅜	Do. 4½ p.c. Red. Cum. Pref.	17/6—19/6	...
160,523	Oct. 9	−/10⅜	−/10⅜	Do. 4 p.c. Red. Deb. ...	90—95	...
110,000	Dec. 18	4	4	Southampton Ord. 5 p.c. ...	77—82	+4
750,541	Feb. 5	5½	5½	Do. 4 p.c. Deb. ...	80—85	...
148,836	Dec. 27	4	4	Swansea 5½ p.c. Red. Pref. ...	97—102	...
350,000	Feb. 12	5½	5½	Do. 3½ p.c. Red. Deb. ...	90—100	...
200,000	Dec. 18	3½	3½			
1,076,490	Feb. 26	6½	5	Tottenham and District Ord....	93—98*	−1
409,835	"	5½	5½	Do. 5½ p.c. Pref.	100—105*	...
62,235	"	5	5	Do. 5 p.c. Pref.	90—95*	...
453,380	Dec. 11	4	4	Do. 4 p.c. Deb.	80—85	...
1,247,505	Oct. 23	6	4	U. Kingdom Gas Cor. Ord. ...	14/—16/—	+−/6
1,085,952	Nov. 20	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	15/—17/—	...
772,709	"	4	4	Do. 4 p.c. 1st Red. Cum. Pf.	14/6—16/6	...
745,263	Dec. 18	4½	4½	Do. 4½ p.c. 2nd Non-Cum. Pf.	13/—15/—	+− 6
1,093,656	Sept 18	3½	3½	Do. 3½ p.c. Red. Deb. ...	85—90	...
378,106	Mar. 6	7	7	Uxbridge, &c., 5 p.c.	90—100	...
133,010	"	5	5	Do. 5 p.c. Pref. ...	95—105	...
1,371,138	Feb. 5	6½	3½	Wandsworth Consolidated ...	85—90	...
2,525,768	"	4	4	Do. 4 p.c. Pref.	82—87	...
1,343,964	Dec. 18	5	5	Do. 5 p.c. Deb.	100—105	...
383,745	"	4	4	Do. 4 p.c. Deb.	85—90	...
400,000	"	3¾	3¾	Do. 3¾ p.c. Red. Deb. ...	90—95	...
558,342	Jan. 29	6½	6	Watford and St. Albans Ord. ...	95—100	...
200,000	"	5	5	Do. 5 p.c. Pref.	88—93	...
200,000	"	5½	5½	Do. 5½ p.c. Pref.	93—98	...
200,000	"	4	4	Do. 4 p.c. Rd. Pf. (1973/8)	85—90	...
100,000	"	33/4⅛	4	Do. 4 p.c. Red. Pf. (1959)	93—98	...
200,000	Dec. 11	3½	3½	Do. 3½ p.c. Red. Deb. ...	83—88	...

a.—The quotation is per £1 of Stock. * Ex. Div. † Paid free of income-tax. ‡ For year. § Actual.

Supplementary List and Provincial Exchanges overleaf.

STOCK AND SHARE LIST—Contd.

Supplementary List, not Officially Quoted, London

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Nominal Quotations Mch. 1.	Rise or Fall on Week.
202,152	Sept. 4	5	5	Ascot Ord.	80—90	...
128,182	Dec. 27	5	5	Do. 5 p.c. Pref. ...	88—93	...
31,035	Aug. 21	–/4½	–/4½	Associated Utilities 4 p.c. Pref.	15/—17/–	...
100,000	Dec. 18	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
17,000	Feb. 19	8	8	Bognor Orig. Ord. 'A' ...	102—112	...
62,210	,,	8	8	Do. New Add. 'A' ...	102—112	...
87,160	,,	7	7	Do. New 7 p.c. max. ...	95—105	...
37,440	Jaa. 29	10	10	Cam. Univ. & Town 10 p.c. max.	145—155	+35
125,970	,,	7	7	Do. 7 p.c. max.	105—115	+15
39,025	,,	5	5	Do. 5 p.c. max.	80—90	...
96,410	Jan. 29	4½	4½	Cardiff 4½ p.c. Pref. ...	90—95	...
55,520	Feb. 19	6	6	Colchester 6 p.c. Pref. ...	95—100	...
90,550	Sept. 18	5	5	Do. 5 p.c. Deb. ...	100—105	...
150,000	Feb. 12	4	4	Croydon 4 p.c. Pref.	70—75	...
130,000	Dec. 27	4	4	Do. 4 p.c. Deb.	80—85	...
65,000	Aug. 21	7½	7½	Eastbourne 'A' 5 p.c.	105—115	...
198,000	,,	6	6	Do. 'B' 3½ p.c.	90—100	...
112,312	,,	5	5	Do. 5 p.c. Pref.	90—95	...
180,000	Dec. 18	5	5	Do. 5 p.c. Deb.	95—105	...
130,580	Feb. 19	7½	7½	Exeter New Ord. (£10) ...	10—12	...
24,000	Aug. 21	8½	8½	Gt. Yarmouth 8½ p.c. max. (£30)	15—20	...
59,400	,,	7½	7½	Do. 7½ p.c. max. (£30) ...	10—15	...
31,160	Dec. 11	5½	5½	Do. 5½ p.c. Deb.	102—107	...
132,600	Feb. 26	8	9	Guildford Cons.	110—120*	...
54,055	,,	5	5	Do. 5 p.c. Pref.	90—95*	...
68,250	Dec. 11	5	5	Do. 5 p.c. Deb.	90—95	...
156,600	Feb. 19	7	5	Hampton Court Cons. ...	75—85	...
86,046	June 19	‡4½	‡5	Holyh'd&N.W.G.&W.Cpn.Ord.	13/6—15/6	...
80,000	Feb. 12	4	4	Lea Bridge 4 p.c. Pref.	65—75	...
60,000	,,	6	6	Do. 6 p.c. Pref.	105—115	...
94,876	Dec. 18	4	4	Do. 4 p.c. Deb.	75—80	...
73,620	Sept. 18	8½	8½	Luton Cons. 'A'	115—125	...
107,960	Feb. 26	4	5½	Mid Kent Ord. (£10)	7½—8½*	–½
230,940	Feb. 5	10	10	Oxford & District Ord. ...	135—145	...
47,112	,,	5	5	Do. 5 p.c. Pref.	85—90	...
58,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	100—105	...
126,193	Oct. 30	7½	7½	Peterborough Ord.	140—150	...
64,990	Sept. 18	7½	7	Redditch Ord.	100—110	...
166,850	Feb. 19	8	8	Romford Ord.	108—118	...
60,000	,,	4	4	Do. 4 p.c. Pref.	85—90	...
44,000	Sept. 18	5	5	Do. 5 p.c. Deb.	97—102	+2
28,570	Feb. 12	5½	5½	Rugby 5½ p.c. Pref.	95—105	...
25,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	100—105	...
42,750	Dec. 11	5½	5½	Do. 5½ p.c. Deb.	103—108	...
110,950	Feb. 26	8	8	Ryde Ord.	100—110*	–10
270,086	Sept. 4	7	7	Slough Ord.	100—110	...
21,000	Dec. 11	5	5	Do. 5 p.c. Deb.	92—97	...
28,872	Nov. 6	5½	5½	S. Midland Gas Cpn. Ltd. Ord.	14/—16/–	...
28,865	Sept. 18	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/—16/–	...
17,225	Feb. 19	5	7	Swindon Cons.	75—80	...
60,425	Dec. 18	5	5	Do. 5 p.c. Deb.	92—97	...
64,380	,,	5	5	Torquay & Paignton 5 p.c. Pref.	82—87	...
130,000	Feb. 12	5	5	Wakefield Ord.	85—95	...
81,650	,,	5	5	Do. 5 p.c. max.	75—80	...
82,000	Jan. 29	6	6	Waymouth Ord.	82—87	...
273,626	Feb. 12	7	7	Wolverhampton Cons. Ord. ...	115—125	...
98,384	,,	6	6	Do. 6 p.c. Pref.	105—115	...
160,000	Dec. 18	5½	5½	Do. 5½ p.c. Red. Deb. ...	100—105	...
106,490	Aug. 21	5½	5½	Wrexham Ord	70—80	...
90,000	Dec. 18	5	5	York 5 p.c. Red. Deb.	95—100	...
133,640	Feb. 19	6	6	Yorktown (Cam.) 5 p.c. Cons.	82—87	...
120,000	,,	5	5	Do. 5 p.c. Pref.	85—90	...
35,000	Dec. 18	5½	5½	Do. 5½ p.c. Deb.	103—108	...

BRISTOL EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Mch. 1.	Rise or Fall on Week
347,756	Feb. 12	5	6	Bath Cons.	99—103	...
1,667,250	Feb. 5	5	5	Bristol, 5 p.c. max.	98—100	...
120,420	Dec. 18	4	4	Do. 1st 4 p.c. Deb. ...	97—100	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	97—100	...
328,790	,,	5	5	Do. 5 p.c. Deb.	113—116	...
274,000	Feb. 26	5	5	Newport (Mon.) Ord.... ...	91—94*	–1½
13,200	Sept. 4	8½	7	Pontyp'l Gas & W. 10 p.c. 'A'	12—13	...
13,600	,,	6	5	Do. 7 p.c. 'B'	10½—11	...
40,000	,,	6	5	Do. 7 p.c. 'C'	10½—11	...
140,778	Feb. 12	5	5	Weston-super-Mare Cons. ...	92—96	...
64,338	Dec. 27	4	4	Do. 4 p.c. Deb.	90—95	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	140—150	...

LIVERPOOL EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Mch. 1.	Rise or Fall on Week
157,150	Feb. 5	5	6½	Chester 5 p.c. Ord.	98—101	...
92,500	Dec. 18	4	4	Do. 4 p.c. Pref.	80—84	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	85—88	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	95—99	...
2,167,410	Feb. 19	6	6	Liverpool 5 p.c. Ord.	101—105	...
245,500	Dec. 18	5	5	Do. 5 p.c. Red Pref. ...	95—100	...
306,083	July 17	4	4	Do. 4 p.c. Deb.	99—101	...
106,280	Feb. 5	10	8	Preston 'A' 10 p.c.	171—181	...
188,219	,,	7	7	Do. 'B' 7 p.c.	123½—133½	...

NEWCASTLE EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Mch. 1.	Rise or Fall on Week
122,577	Feb. 19	7	7	Blyth 5 p.c. Ord.	113—118	...
732,000	Feb. 19	4	4	Hartlepool G. & W. Cn. & New	63½—64½	...
2,430,267	Feb. 5	5	5 7/10	Newcastle & Gateshead Con.	19/9—20/3a	+–/6
682,856	,,	4	4	Do. 4 p.c. Pref.	86½—87½	...
776,706	Dec. 27	3½	3½	Do. 3½ p.c. Deb.	78—80	...
277,285	April 24	5	5	Do. 5 p.c. Deb. '43 ...	101—103	+1½
332,351	Feb. 5	6	6	Sunderland 6 p.c. max. ...	106—107*	...

NOTTINGHAM EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Mch. 1.	Rise or Fall on Week
542,270	Feb. 12	6	9	Derby Con.	103—108	...
55,000	Dec. 18	4	4	Do. 4 p.c. Deb. ...	98—103	...
20,000	Dec. 18	5	5	Long Eaton 5 p.c. Pref. ...	9—11	...
80,000	,,	5	5	Do. 5 p.c. Deb. ...	100—105	...

SHEFFIELD EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Mch. 1.	Rise or Fall on Week
10,000	Feb. 19	10	10	Great Grimsby 'A' Ord. ...	170—180	...
6,500	,,	10	10	Do. 'B' Ord. ...	170—180	...
79,000	,,	10	10	Do. 'C' Ord. ...	160—170	...
1,806,339	Feb. 26	6½	6½	Sheffield Cons.	123—125*	–2
95,000	Jan. 2	4	4	Do. 4 p.c. Deb.	98—100	...

a The quotation is per £1 of Stock.
* Ex. div. ‡ For year.

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